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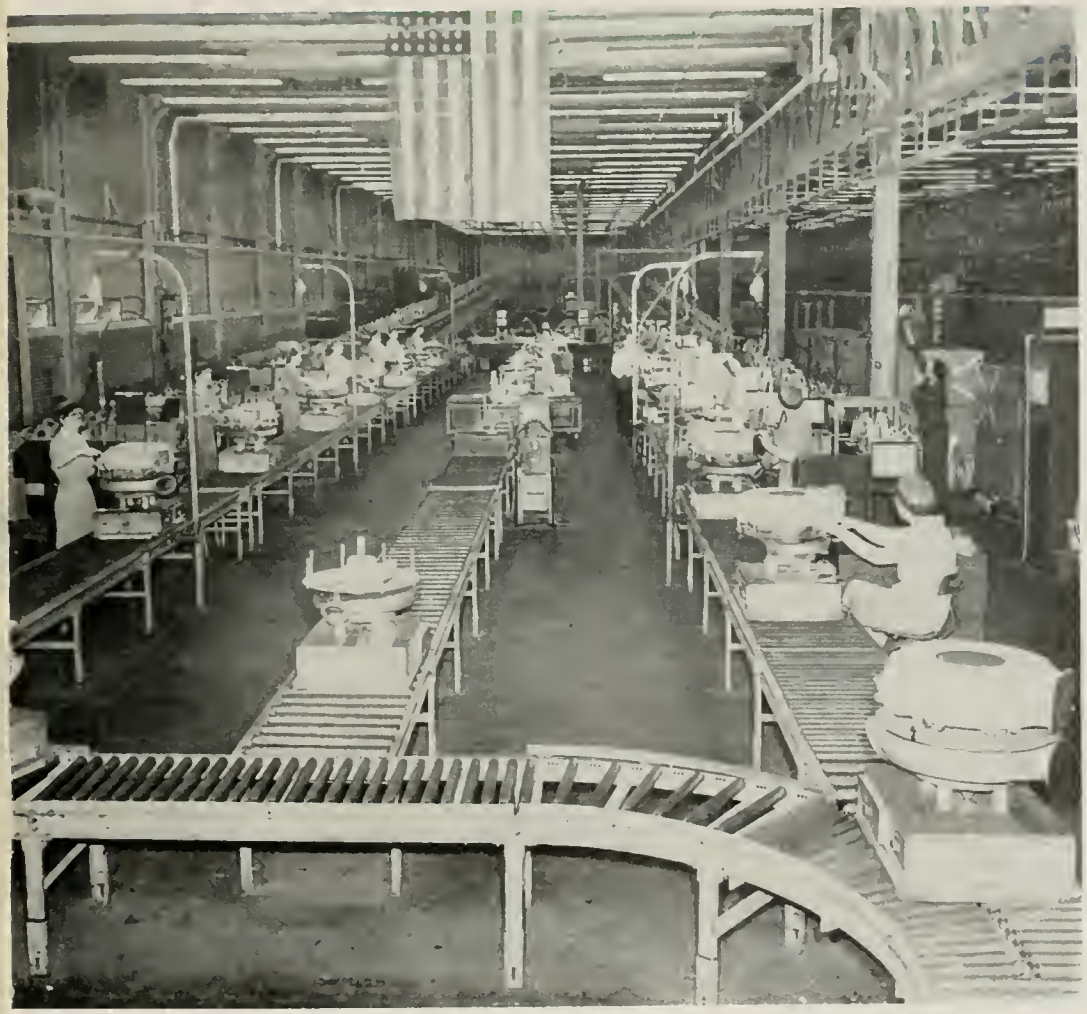

January
1944

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ENAMEL STANDARDS

HEATING RESEARCH

GOING IN THE ARMY?

NORTH OF GREEN

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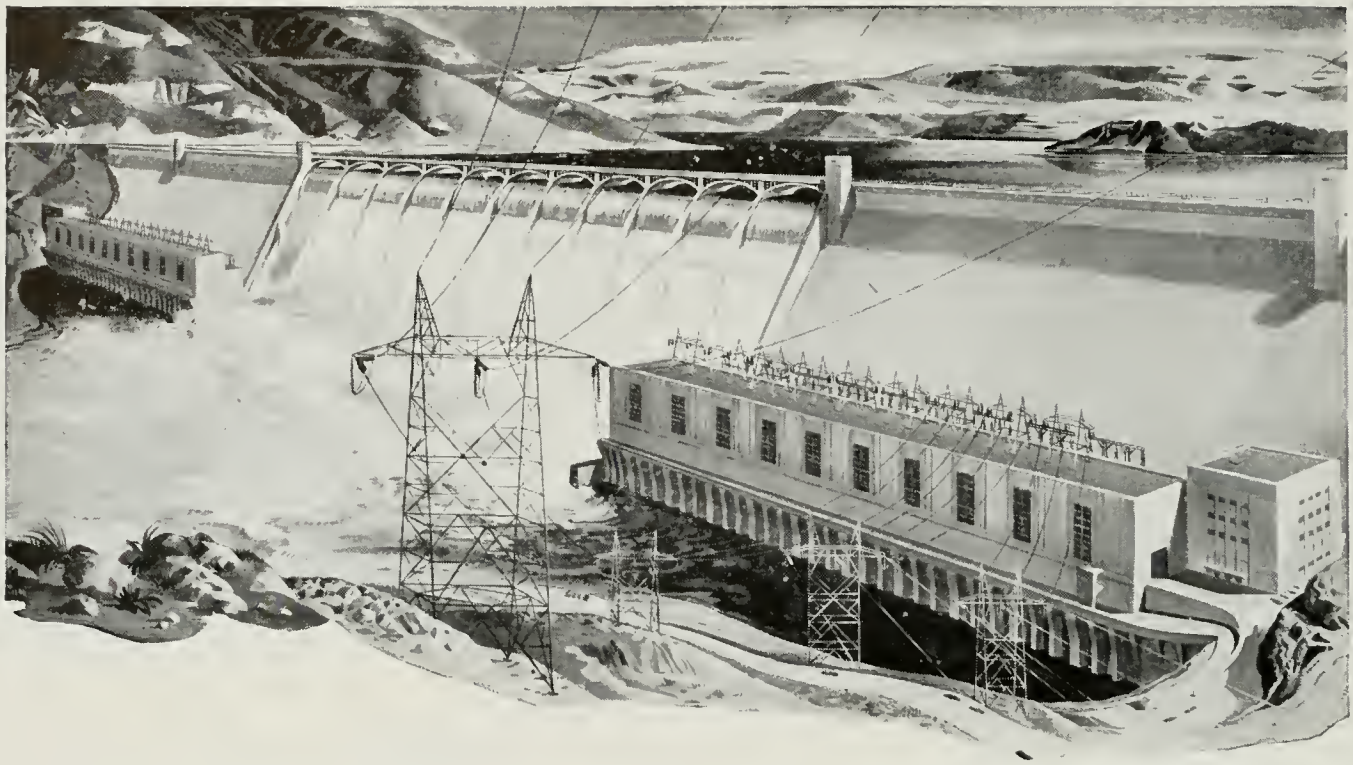
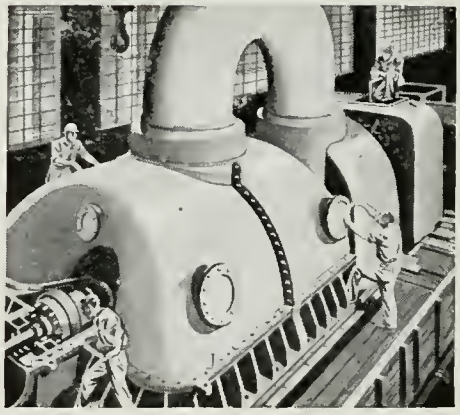


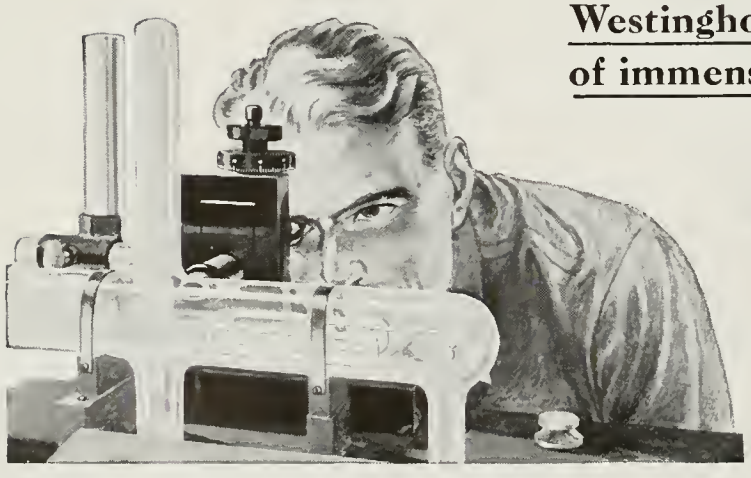
Westinghouse generators make power for a nation at war...

From the world's largest water-wheel generators at Grand Coulee Dam—from Westinghouse steam-driven generators in power plants throughout the nation—flow billions of kilowatts of electric power to turn the wheels of America's war industry.

Westinghouse combines the power of a thousand human skills...

A workman at a lathe, a girl on an assembly line, an engineer on the test floor—theirs, and the countless other skills of 103,000 Westinghouse employes, are welded into a single great production force. Their vast experience and knowledge help to produce the vitally needed power-generating equipment to drive America's mighty war machine.



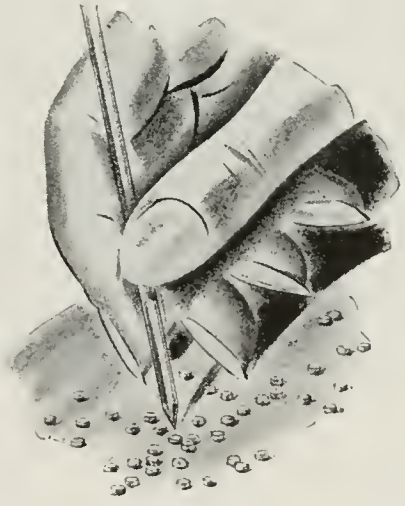


Westinghouse contributes the power of immense new knowledge...

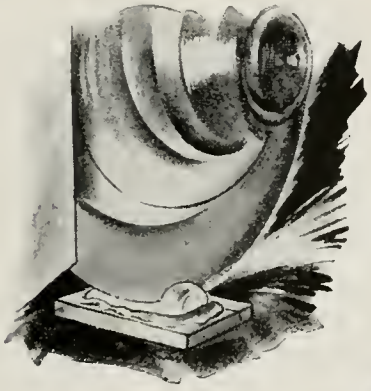
When the incredible weapons born of wartime research are reforged for peacetime service, the daily miracles that electricity will perform are certain to create new and finer standards of living . . . while the cost of electricity continues to decrease as our nation's power-generating capacity continues to increase. Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. Plants in 25 cities—offices everywhere.

The synthetic sapphire that becomes a precious jewel...

1. High over Berlin on the instrument board of a bomber, these synthetic sapphires become the most precious jewels in the world. They're man-made jewels for instrument bearings. Without them, no bomber could drop its load with accuracy, no warship could navigate. Before Pearl Harbor most of these synthetic jewels came from abroad. But today industry is mass producing its own with the help of diamond blades and polishing compounds such as made by Carborundum.



2. Man-made sapphires are created by fusing aluminum oxide. To turn the rough boule into a bearing requires more than 100 precision operations, including cutting, grinding and polishing. No tolerance over 0.0003 in. is permissible. One of the best abrasives for producing a sapphire bearing is the diamond. So diamond grinding compounds by Carborundum are widely utilized.



3. War has given enormous impetus to the art of grinding. In industry, you may find operations which might be done better with abrasives. Carborundum engineers will be glad to consult with you on any such problem. The Carborundum Company, Niagara Falls, New York.

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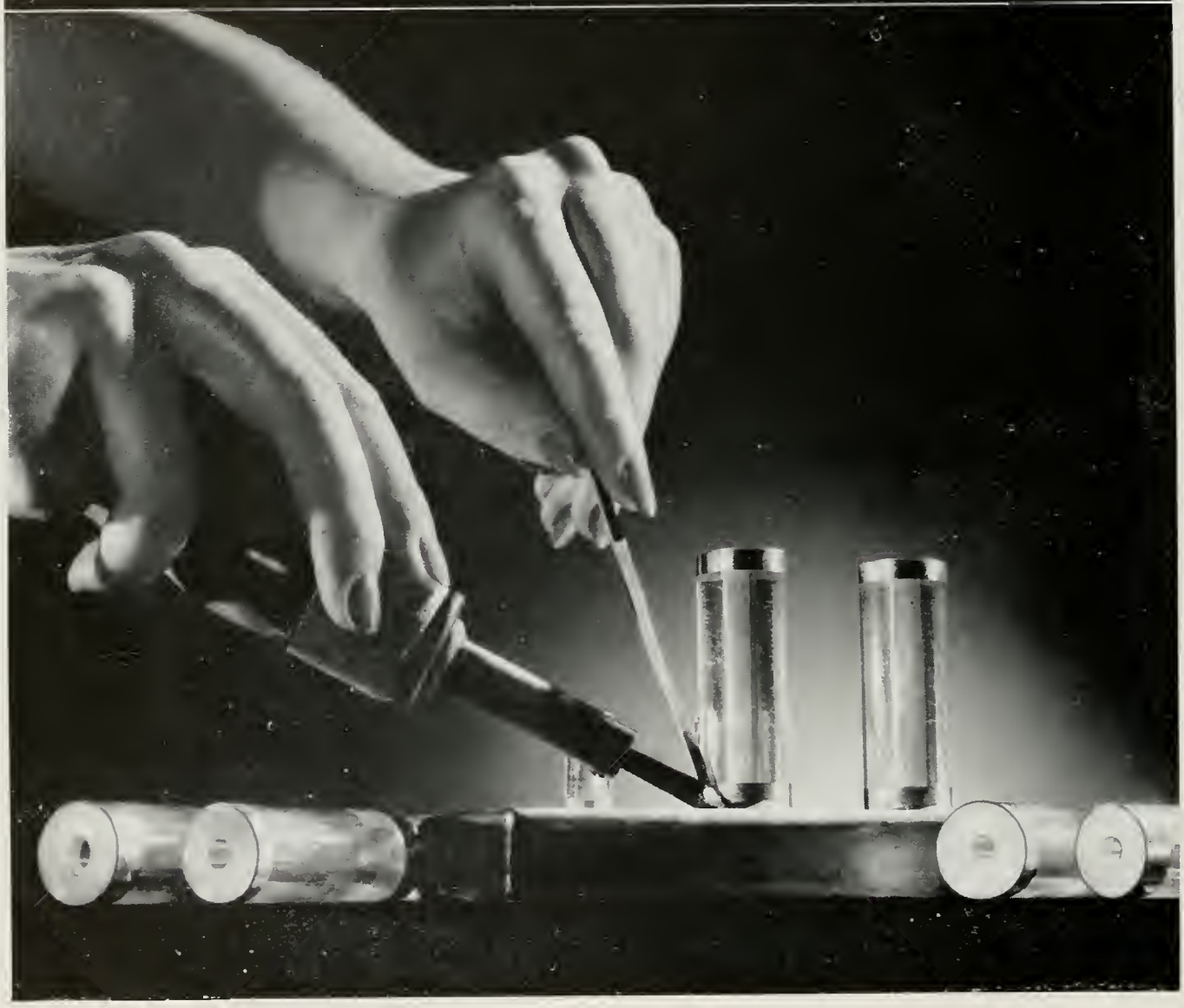
Imagine soldering metal to Glass!



HERE'S one for the book! The young lady is soldering metal to glass to make an important piece of electrical war equipment, and she doesn't have to be fussy about it either. She just solders!

The reason this can be done today is that some time ago Corning developed a method of firmly attaching a thin film of metal to glass, as a base for the solder. It was just one of many glass-metal problems that were once called "impossible."

Being ready with ideas has been the glass industry's greatest contribution to our war effort. That, and the ability to mass produce essential glass without delay.

Take Corning for instance. Here research found ways to mass produce essential optical ware. Insulators, aerial and naval navigation lenses, bulbs for electronic tubes, these and countless other war needed items are being turned out in vast quantities.

On the civilian front, Corning right now is supplying glass piping, and valves, nuts and bolts that resist chemical attack. Glass springs that apparently never wear out. Glass acid pumps that replace scarce metal alloys and give longer service in the bargain!

Glass isn't taking a back seat now, or after victory. Too many people are finding out something about its unusual qualities to ever let this happen.

They are discovering that glass is versatile. It has astounding strength. It can be shaped with great accuracy. It resists corrosion and abrasive wear. And they're finding out, too, that Corning knows glass, not only as a producer but as a developer of glass ideas.

In engineering, too, glass is a material with a brilliant future . . . In the years to come, keep your eye on glass! Corning Glass Works, Corning, N. Y.

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Research in Glass

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Cover . . .

Airplane turbosuperchargers in production. As the superchargers are moved down this long line at General Electric's Fort Wayne, Ind., plant, each girl worker adds a part or does a particular operation. When they reach the end of the movable track, shown in the foreground, the turbosupercharges are completely assembled and ready for final inspection. — *Courtesy General Electric.*

★

Frontispiece . . .

Typical of America's war workers are these welders who are sealing the joints of a frame for a turbo-generator which, when completed, will be part of generating equipment to turn out electric power for war-busy industrial plants.—*Courtesy of Westinghouse.*

Enamel Utensil Standards

By Gordy Johnson, Cer. '44 and Louis R. McCreight, Cer. E. '44

Forty thousand tests made in the last four years! This is the almost unbelievable record of the Enamel Standards research laboratory here at Illinois. This work is part of the program of cooperative research which is being carried on in the Engineering Experiment Station, Department of Ceramic Engineering for the Enameled Utensils Manufacturers Council.

The E. U. M. C. is an organization of sixteen manufacturers of enameled utensils. The group is under the direction of Mr. D. S. Hunter of S. D. Hunter and Associates of Cleveland, Ohio. The work of the council concerns itself with problems which are of an industry-wide nature and does not delve into individual problems unless some aspect is of general interest to all of the companies.

The research project here at Illinois is in its fourth year and is a full-time cooperative research project. Dr. A. I. Andrews is the director, and F. A. Peterson is employed full time on the work of the project.

The work was started since the industry felt the need for the development of standard test methods for the testing of enameled ware. The main objectives have been (1) development of standard test methods, (2) the study of enamel properties as affected by chemical and physical variables, (3) the development of a commercial standard to cover enameled ware, and (4) cooperation with government agencies in the setting up of procurement specifications covering enameled ware.

At the present time there are three standard test methods which are used for the determination of the resistance of enamaled ware to impact, thermal shock, and acid solubility. These three tests are also incorporated into CS 100-42, a commercial standard entitled "Multiple-Coated Porcelain Enameled Steel Utensils." This standard was set up in the Division of Trade Standards in the National Bureau of Standards.

The use of standard tests of this type throughout an industry gives the men in each representative plant a measuring stick whereby current production can be compared with past production, and with other ware of the same sort. In this way improvements can be made and the extent of the improvements can be noted.

Impact resistance is the resistance of enamel to mechanical abuse such as that encountered when the pan is dropped on a hard surface. It is measured by the falling weight method using a special machine which was designed here at Illinois. The pan is mounted upside down on a smooth plate which is tilted at an angle of 45°. This machine is adjustable so that the outside bottom of the pan may be brought directly below a vertical tube. The weights are introduced at the top of the tube and are allowed to fall and strike the pan from various heights until failure of the pan occurs. A pan of standard dimensions was designed for this test in order to minimize the effect of variation in the radius of curvature between the bottom and sidewall of the pan which may occur in the pans from the various manufacturers. The pan is struck on this curved surface for it is the spot most vulnerable to fracture on an enamel pan. The average of ten tests on a pan is taken

General View of the Enamel Standards Laboratory

as its impact resistance rating, and five pans so tested constitute a full test.

The ability of enameled ware to withstand rapid temperature changes, such as that encountered when a pan boils dry and is filled quickly with cold water, is measured by subjecting the pan to a thermal shock test. In this test a pan is heated dry for a specified length of time on a hot plate which is at a definite temperature; then the pan is removed from the plate and a measured volume of water at 20°C is immediately poured in and allowed to remain for ten seconds. The pan is then sponged dry and returned to the hot plate, the temperature of which has been increased. This procedure is repeated until failure of the enamel occurs.

In the preparation of many foods a utensil is subjected to attack by various acids including citric, acetic, lactic and others. The resistance of the enamel to solution by these acids is determined as follows. A disc is cut from the bottom of a pan and accurately weighed. A glass cylinder is then clamped on and a measured volume of a 6% citric acid solution is poured in. After heating for a definite length of time at the boiling point, the sample discs are dried and re-weighed to determine the amount of enamel taken into solution. A long glass tube set in the top of the apparatus acts as a reflux condenser and, therefore, the concentration of the acid solution remains constant throughout the boiling period.

A technical committee consisting of six men from the industry includes Professor A. I. Andrews and Mr. F. A. Peterson. It is the duty of this committee to meet and consider technical problems. Their decision on the various problems are then presented at council meetings for the action of the council. In this way much time is saved for the large groups and more complete discussions on the most important work can be heard by the whole council.

Each month test data is published in a coded report for the members of the council. From this data each manufacturer may obtain a comparison between his wares and that of other manufacturers, but cannot tell whose ware is represented by the rest of the data. This report also gives him a comparison between his past and present production and shows him where improvement is needed, and how much improvement has been made.

Testing Impact Resistance with Falling Weight Device

At the present time these manufacturers have turned

Mr. A. F. Peterson, Director of Investigation

to war work—everything from heat treating of steel to making precision parts for instruments—since they have been limited to only a percentage of their pre-war production of enameled utensils. The bulk of their present production goes to the Armed Forces, hospitals, and lend lease; the remainder is for civilian consumption.

The council should be commended for their unselfishness, since even companies who are not members of the council may obtain test procedures developed in this work.

The fact that the council has made great progress in producing an improved product is evidenced by the comparison of test data on ware tested several years ago and the data being collected currently. The manufacturers have entered into the research program wholeheartedly, and the application of results obtained on this project has shown its effect.

"SUITCASE" ELECTRON MICROSCOPE

General Electric engineers have assembled the elements of their electron microscope in two portable units, each of suitcase size, it has been disclosed by Igor Bensen, development engineer of the General Electric Company's electronics laboratory. Bensen described the "suitcase" unit in a talk to the Electron Microscope Society in New York City. The electron microscope is 10 times more powerful than the best light microscope and operates on 110-volt a-c power.

Emphasizing that the "suitcase" microscope is not a production model, Mr. Bensen explained that it is a step nearer the day when a small, compact, and easily operated electron microscope will be available for wide-spread use by doctors and research men. This model will be used by engineers for experimental purposes. It could, for example, be flown to and operated in field hospitals on the fighting fronts. The microscope proper weighs 78 pounds. A vacuum pump, also of average suitcase size, comprises the second unit. It weighs 55 pounds.

Weight of the microscope can be reduced still further when certain lightweight alloys can be used to replace steel and other heavy metals used in the instrument, Bensen explained.

Results of . . .

Heating and Ventilating Research

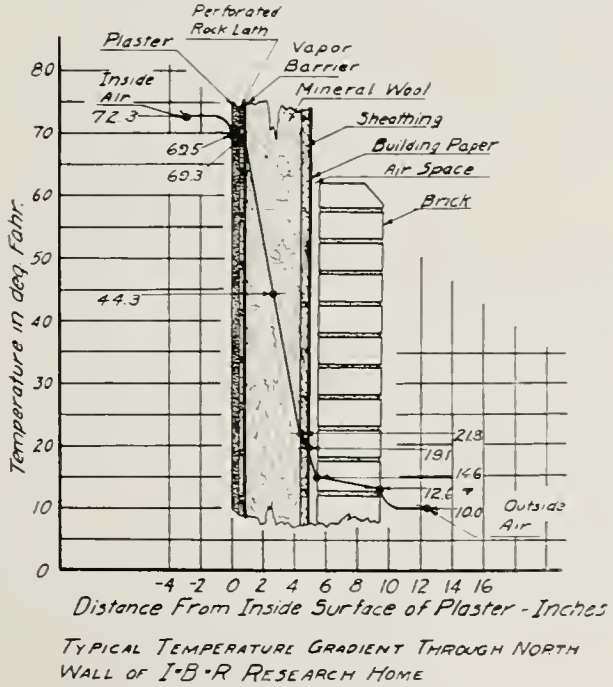
By CHESTER D. MARQUIS, M.E. '44

It is the purpose of this article to enlarge somewhat upon the procedures and results of the tests carried on at the I. B. R. Research home as introduced in last month's Technograph.

Of course, the core of the operation of the home as a testing unit is the heating plant. It consists of a one-pipe, forced circulation, hot-water system connected with an oil burning boiler rated by the I. B. R. at 63,000 B.T.U. per hour. Radiators are of the cast-iron, small-tube type, 19 inches high, and are located in open recesses below the windows. The radiator size for each room was determined by calculating heat losses of the room and was based on a heat emission rate of 200 B.T.U. per hour per square foot of radiation with mean water temperature of the system at 195°F.

Instruments used in testing are extremely important. Nearly 200 copper-constantan type thermocouples are located at strategic points throughout the walls, rooms, and heating system of the house, and their temperatures to 0.1°F may be read quickly by means of a sensitive control potentiometer switchboard located in the basement of the home.

A continuous record is kept of the temperature of each of the six rooms, the outdoor weather station, and the attic by means of recording mercury thermometers. Key thermocouples may be connected to a ten-point recording potentiometer when accurate, permanent temperature records are desired for special tests. The temperature gradient data for the north wall section was obtained in this manner and is illustrated in figure 1. Other instruments are available to show water flow at various points in the system.



TYPICAL TEMPERATURE GRADIENT THROUGH NORTH WALL OF I·B·R RESEARCH HOME

Figure 1

moisture at 85 critical locations, quality and flow of flue gases, and fuel and power consumption. Location of instruments and radiators are shown in the floor plans, figures 2 and 3.

The general procedure in testing is to take readings of temperatures at specified locations about the house five times during the day, along with various other data such as humidities, weather conditions, operating times of burner

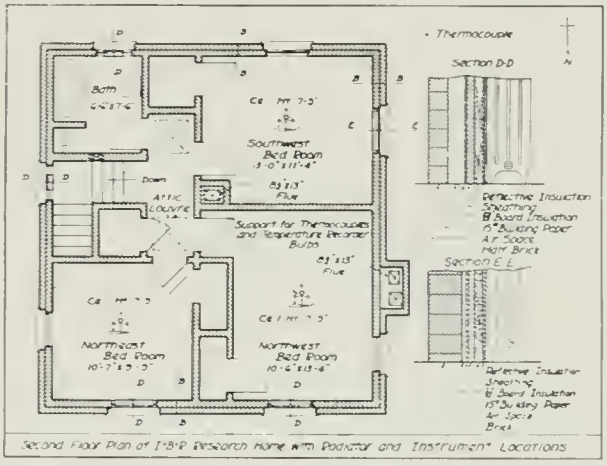


Figure 2

and circulation, number of operation cycles, and fuel and power used. After a period of testing long enough to give a wide range of outside temperatures and weather conditions, data are tabulated and graphed and results analyzed and published.

The heating system was controlled in these experiments by a heat anticipating thermostat at the thirty-inch level in the living room set at 72°F day and night.

In the first testing season, the winter and spring of 1941, two series of tests were run. In the first, known as the A series, the burner and circulator started when

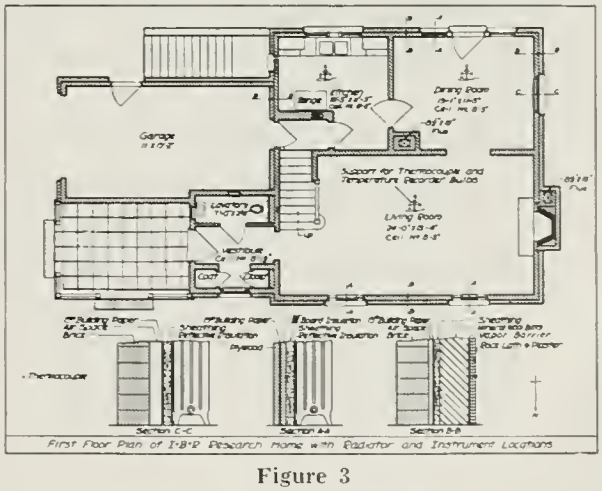


Figure 3

the thermostat indicated a need for heat and ran until proper room temperature was reached. The burner ran whenever the low limit aquastat in the boiler indicated a set temperature had been reduced in the cooling of the water system. A flow valve was present to control circulation of water in the system.

In the B series, the low limit aquastat and the flow valve were eliminated, the result being that water continued to flow through the system by convection and emit heat through the radiators, its temperature varying between maximum boiler temperature of 200°F and the room temperature, until the thermostat started another cycle.

It was found, in general, that increased burner operating time, burner power and fuel were required for series A for temperature differences up to about 55°F, where they became equal to those of the B series, and that the cost of operating the heating system over the average heating season under series A would be approximately 11.7% higher than for the B series.

The tests showed further that the thermostat could keep the temperature variation at its thirty-inch level to 1°F and that the maximum floor-ceiling temperature difference of the second floor averaged 1.3°F higher than the first floor. Heat losses through various parts of the house were studied and temperature gradients investigated.

In the second testing period, the 1941-42 heating season, test series C and D were run corresponding to A and B respectively concerning low-limit aquastat and flow valve conditions and both involving a night setback of the thermostat from 72°F to 66°F from 10 p. m. to 5:30 a. m.

By comparing the corresponding series it was found that at the average Urbana indoor-outdoor temperature difference of 34°F, the saving of fuel of series C over A was about 10.4%. Cycles per day and operating time of boiler and circulator were similarly reduced.

In series B and D, values of operating time, power and fuel consumption were substantially equal for indoor-outdoor temperatures up to 34°F, where B series values increased slightly more rapidly. The yearly fuel savings with series D would be practically negligible since differences in fuel consumption were small, even for the infrequent, large indoor-outdoor temperature differences.

Except for the morning warmup period, the night setback did not affect daytime temperature conditions. In average winter weather, cooling of the house during the 7.5-hour heat reduction period was not more than 6°F. The results of an average day's testing may be seen graphically in figure 4.

The 1942-43 testing season was marked by a 30% reduction of pipe weight in the system and 30% reduction of radiation surface. Extrapolation of curves for operating time of the system of the previous year's tests showed that the radiation surface could be reduced and the same results obtained.

Four series of tests were run in this period, corresponding to conditions of A, B, C, and D series except for the reduced system size. Data are not available as yet for these tests.

This year, 1943-44, a gas burner was installed, with which more delicate control and lower B.T.U. could be obtained. Baseboard radiators, consisting of pipes around outside walls at floor level were introduced, whose sizes and lengths were determined by calculated heat losses of the rooms. This system is performing quite satisfactorily —and data are being collected at the present time.

It is hoped by both sponsors and workers at the home that through their efforts, the heating system of your home of tomorrow may be one of greater efficiency, economy, and beauty.

Grateful acknowledgement is made to the Journal section of the American Society of Heating and Ventilating Engineers of "Heating, Piping, and Air Conditioning" for reference material and cuts used in this article.

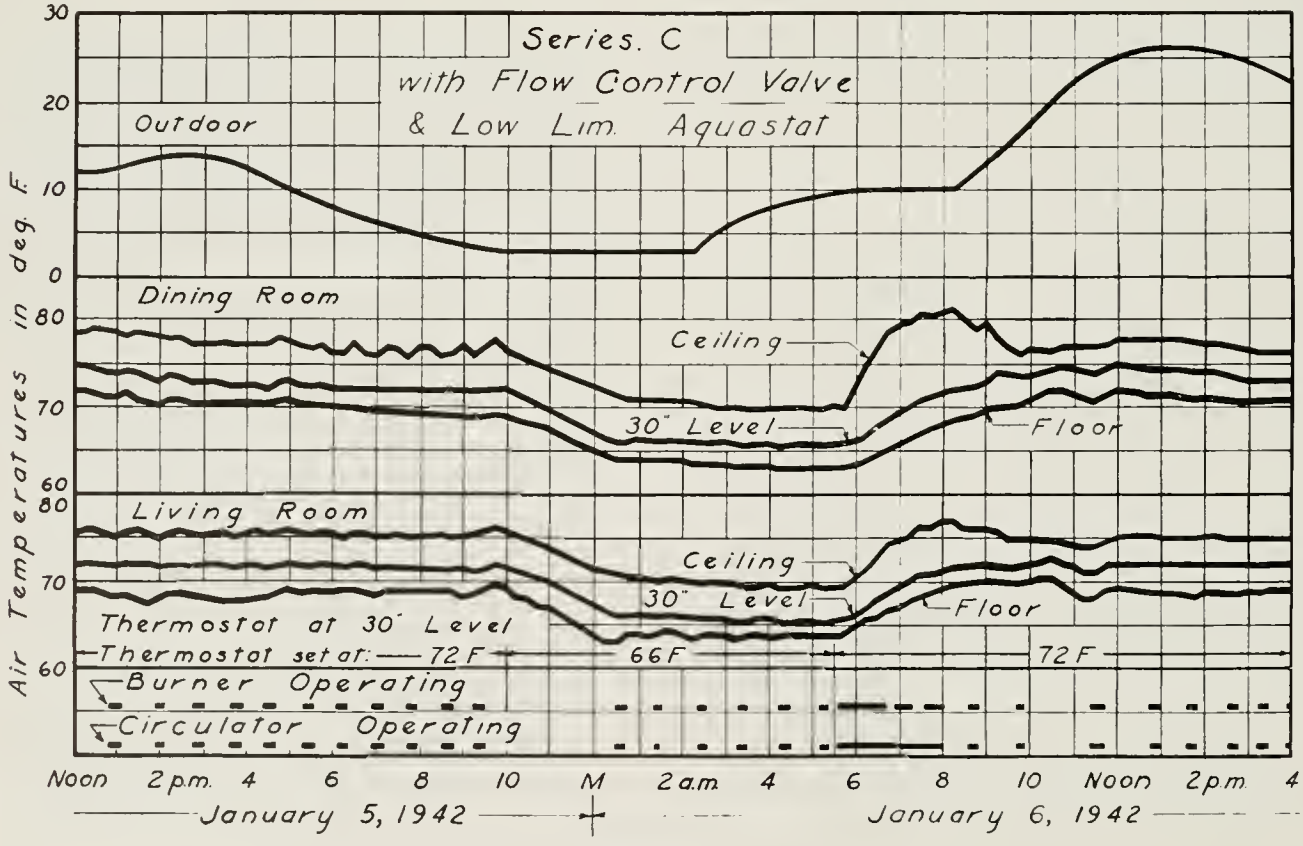


Figure 4

Going in the Army?

By MARK ROBINSON, Ch. E. '47

Oportunities for engineers in the armed forces are rather limited at the present time. Before enlistments were closed over a year ago, a man might volunteer for any branch of the service for which he felt himself qualified. Now, however, men are assigned to units on the basis of screening tests and interviews given them at reception centers.

There are, in general, only two types of units to which a man would probably be assigned—combat units and army specialized training units. Because the army has about 50,000 surplus officers, it is unlikely that a man would be assigned to an officer candidate school, at least at the present time. This means that the only combat jobs open to an engineer are the non-commissioned technical ratings.

Several branches of the army, particularly the corps of engineers, have use for engineers. An engineer combat unit has in addition to the usual non-coms, the following technical posts:

With rating of master sergeant:
- Construction supervisor,
- Battalion motor sergeant.

With rating of technical sergeant:
- Mechanic, foreman.

With rating of staff sergeant:
- Company motor sergeant,
- Construction foreman.

With ratings below that of sergeant:
- General automobile mechanic,
- Draftsman,
- Electrician,
- Mechanic.

In additioin to these jobs, an engineer general service regiment has the following posts:

With rating of master sergeant:
- Structural designer,
- General electrician,
- Regimental motor sergeant.

With rating of technical sergeant:
- Mechanical draftsman,
- Structural draftsman,
- General surveyor.

Other positions with varying ratings are:
- Aerial photographer,
- General photographer,
- Topographic draftsman,
- Master mechanic,
- Railway draftsman.

It can readily be seen that most of these positions, though they call for engineering training, do not necessarily require the abilities of a graduate engineer. They are all open to men with little or no college training who have had sufficient practical experience to enable them to fill the position adequately.

Until recently, the signal corps was in need of electrical engineers as officers, and there may still be a demand for them. There are opportunities for mechanical engineers in the ordnance department.

On the whole, the picture is this: As long as the army has surplus officers, engineers and others, and is discharging engineer officers who have had years of college, civilian, and military experience, there is little likelihood that more men will be trained as engineer officers.

The majority of engineers will probably be assigned to the ASTP. Men who are assigned to an ASTP unit will have a chance for O. C. S. if casualties necessitate training new engineering officers.

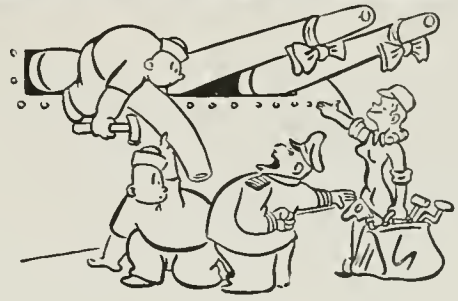
The navy also offers some opportunity for engineers. Analogous to the non-coms in the army are the technical petty officers. The navy will always have need for men trained in running and servicing engines of all kinds.

The fact that the navy needs engineers is evidenced by the large number of V-12's that are studying engineering. Some engineers will have an opportunity to go into an advanced V-12 unit.

All in all, it appears that there is little real opportunity for engineers going into the service to practice their profession. They will have to wait until things return to normal after the war to start their actual engineering practice.

"That's the guy I've been laying for," muttered the little red hen, as the farmer crossed the road.

"BEAUTIFUL" WORKING QUALITY



It *was* a man's world. Then came the war! Then came the call for workers of the fair sex. Thousands of 'em—"God-Bless-'em." Well, we're neutral in this battle of the sexes for whether you're a big rugged he-man ruling bold black outlines for a dreadnaught or a choice bit of femininity putting the finishing touches to a design for a dainty dial, Higgins will match your skill with "Beautiful" working quality.

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WE WILL PAY 2c EACH
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GOOD WIRE HANGERS
(Please Do Not Bring Rusty Ones)
BRESEE BROS. CLEANERS
518 E. Green, Champaign, Ill.

North of Green Street . . .

By JACK WILKINSON, Cer.E. '44

PI TAU SIGMA

On Sunday, January 9, 1944, at the Inman hotel, the Illinois Alpha chapter of Pi Tau Sigma, National Mechanical Engineering Honorary Fraternity, initiated eleven neophytes into its mysteries.

The initiation of the aforementioned is novel in the sense that they will completely supplant the veteran actives next semester, and hence, it is only proper and fitting to honor the latter men who have distinguished themselves in the mechanical engineering curriculum and will have consequently received their synthetic sheepskins come February. They include: G. P. Belson, C. F. Brown, W. E. Cofoid, T. C. Hartley, President H. F. Hrubecky, Treasurer F. L. Kahl, Vice-president R. E. Kraft, J. A. Miller, E. E. Rittenhouse, W. D. Stanley, and V. K. Viitanen.

Prof. S. Konzo acted as toastmaster or as he so aptly put it "roastmaster." His steady flow of wit kept the entire assemblage in a continual humorous state, and the author wishes to extend this formula to all future chairmen of banquets, "When selecting a toastmaster, place S. Konzo at the top of the data sheet."

The above gentleman introduced Vice-president R. E. Kraft, who welcomed all of the new members while the response for the initiates was given by D .H. Offner. Following this, President H. F. Hrubecky presented the new members; he also presented, on behalf of the actives, a musical memento to Prof. H. J. MacIntire, the faculty adviser of the fraternity, whose unstinting and valuable guidance has been a source of admiration to the men of Pi Tau Sigma in the past as well as the present.

The main event on the program was the address by Prof. H. E. Babbitt, professor of civil engineering, whose main theme dealt with the position of the engineer with respect to the problem of organization on a general unified basis. No further need be said of the success of the speech since the U. of I. engineering staff boasts of Prof. Babbitt as being one of its distinguished and most versatile orators.

In conclusion, Pi Tau Sigma wishes to announce its latest bearers of the Carnot Cycle, symboy of highest efficiency. They include R. J. Albert, R. E. Beckett, D. Denis J. R. Harder, H. Johaningsmneir, C. Marquis, D. H. Offner, J. Pechloff, R. Porter, R. Sandstrom, and R. Wagner.

ENGINEERING DEGREES

Three Illini alumni have been granted permission to qualify for professional degrees in engineering at the University of Illinois. These men are William S. Debenham, Cer. E. '35, employed by Carnegie-Illinois Steel Corp., Chicago; Stuart F. Kasters, C.E. '13, employed by the Stone and Webster Engineering Corp., Boston, and J. A. Bottomly, Mining and Metallurgical Engineering '30, of the Department of Mining and Metellurgical Engineering.

The candidates must have had at least eight years of acceptable engineering experience after receiving the degree of Bachelor of Science, and that for five years has had responsible charge of engineering work.

The committee on professional degrees has found these men worthy of consideration through their contributions to engineering development and technical literature and their activity in engineering societies.

The degrees will be conferred upon them when they have submitted the required theses subject to approval by the board. The theses will be of the nature of major technical reports or plans and specifications for major engineering projects designed or directed by the candidate.

KERAMOS

On January 4, after a week of "neophytic" tasks, three men were initiated into Keramos, Ceramic professional. The traditional ceremonies were concluded with a dinner on January 6, at which the new actives were guests of the society.

The newly initiated are Don Hamer, Cer. E. '45, Lee Fuller, V-12, and Jack Wilkinson, Cer. E. '44.

Following the dinner a meeting was held at which officers were elected. The new officers are: President, Raymond G. Moore; Vice President, Gordon Johnson; Secretary-Treasurer, Jack Wilkinson, and Herald, Bill Prentice.

Chi Epsilon During the 1943-44 Semester

Chi Epsilon began the semester with the following men in office: Bob Sproat, President, Bob Washer, Vice-president, John Ascherman, Secretary, and Joe Dust, Treasurer.

The first meeting of Chi Epsilon was a business meeting. However, soon after men eligible for membership were chosen and a meeting was held to decide on the pledges. The men pledged were Dwight Glasscock, V-12 senior, Paul Monahan and Wendell Wilson, junior V-12's, Harold Wilder, senior, and Jim Wood, junior.

A picnic followed at Hessel Park. Here the actives met the pledges and football and baseball were played with Prof. Bill Oliver, faculty advisor, playing and coaching (and off the record, fellows, he's a regular guy). Two weeks after the picnic a smoker was held in the faculty lounge of the Union building. At this meeting, the pledges reported on their duties. Harold Wilder gave a lengthy account of measuring the flow in the Boneyard and Jim Wood gave an oral biography of Prof. Vawter's life. By now poor Jim is getting back in good standing with Prof. Vawter.

The next meeting was the biggest of all. This was the initiation banquet held at the Union building. The five pledges were initiated first and then the student and faculty members enjoyed dinner in the Federal room. After dinner the group retired to the faculty lounge where Prof. Babbitt told the "Young Fellows" about registration of engineers, a topic very important to students as potential professional men.

Following the initiation banquet, the elections of officers took place. They are: John Ascherman, President,, Wendell Wilson, Vice-president, Jim Wood, Secretary, and Paul Monahan, Treasurer. These men were installed at the semester social meeting at Prof. Oliver's house. Refreshments were served and both students and faculty men had a "bang up" good time.

(Continued on Page 14)

CUSHIONING *Flagships* FOR EASY LANDINGS

GLIDING in to an easy landing as a climax to a safe, comfortable flight is the result of attention to many details. That "cushioned landing," for example, is prepared before the flight by a serviceman as pictured above. He is giving the oleo struts their exact amount of "air cushion" — and an Airco gas regulator does the job accurately. The same method is used for controlling the air pressure to balance the hydraulic system which operates landing flap brakes and retractable landing gear—and Airco nitrogen is the gas widely used for this purpose.

Numerous are the aviation uses of Air Reduction gases and apparatus. For instance, an Airco regulator contributes to comfortable flight at high altitudes . . . arc welded jigs make possible mass production of airplanes . . . gas welding and cutting torches, as well as gas cutting machines play vital roles in the production of struts, engine mounts, and many other important aircraft parts.

With these products and through its role as a leading producer of atmospheric and chemically derived gases, Air Reduction is helping to facilitate essential operations in almost every major industry — from shipbuilding to food packing. If you would like to receive our informative publication "Airco in the News," we shall be glad to send a free copy. Write to Mr. G. Van Alstyne, Dept. C. P., Air Reduction, 60 East 42d Street, New York 17.

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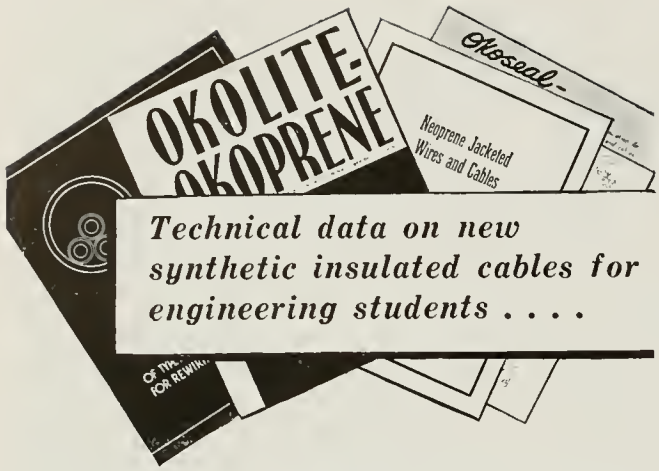
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(Continued from Page 12)

The semester functions of Chi Epsilon were brought to a close at this meeting. Prof. Oliver will continue as advisor and to him and the new officers, the graduating seniors wish a happy and successful coming semester.

Semester Proeeeding of A.S.C.E.—Student Chapter

The student chapter of the American Society of Civil Engineers began the semester with a great flourish. First on the list of meetings was a technicolor movie of the Colorado River Aqueduct. This marvelous structure was shown from beginning to completion, from its source to its end in Los Angeles. The aqueduct dodged mountains and plunged across deserts in a manner that quite thrilled every engineer present.

The society carried on under Hugh Boyd, President, Dave Webster, Vice-president, John Ascherman, Secretary, and Bob Sproat, Treasurer, and came up with another smash hit. This time it was a movie of the Chicago Subway. Ralph Peck of the C. E. faculty, being an engineer on the subway commented about it, and cleared up many questions in the minds of the men in Prof. Babbitt's C. E. 41 class.

Third on the list of meetings was a lecture by Dean Palmer of the Architecture school. Dean Palmer's lecture was entitled the "Five Great Domes" and was concerned with the domes of the world's five greatest cathedrals. The lecture was an illustrated one and was especially interesting in that Dean Palmer was able to relate little stories showing the whims and fancies of the ancient engineers.

Mr. George Massey, consulting engineer and retired director of A. S. C. E., spoke at an afternoon meeting. Mr. Massey's topic was "Engineering Experiences." The talk was both thrilling and educational, for Mr. Massey has traveled the world over.

The final meeting of the A. S. C. E. was held January 13. This was a dinner meeting and joint meeting, bringing together the student chapter and the central Illinois Section. Prof. Walker of Metallurgy spoke on "Armor Piercing Projectiles" and the interest that he aroused can best be explained by saying that Prof. Walker is one of the few individuals in the United States to win the Army-Navy E award for his work in the field of armor-piercing projectiles. Prof. Walker had numerous exhibits of shells and guns and passed them about so that the men present could actually see what they had read so much about. The evening was highlighted by Prof. Babbitt's grand stand catches of the shells ejected from the guns.

The officers had planned an inspiring membership campaign. Many members had left for the service but many engineers who came to the campus in service wished to join as did men from the architecture school, so that now membership is back to normal.

The final business of the semester will be the election of new officers January 21.

The A. S. C. E., like similar organizations, has had some hard moments to live up to its past reputation, but it has pulled through, so those of us who are leaving can wish of the new men just one thing—namely—keep it going, it's the guiding way for a student on his way to become a professional man.

ASME

The last meeting of the student branch of the ASME was held in the Mechanical Engineering Laboratory with Professor M. K. Fahnestock giving the address of the evening. Professor Fahnestock, who is a Research Professor in the Mechanical Engineering Department currently working with the University College of Medicine on the physiological effect of air conditioning on the health of the human being, and who is also Assistant Director of the Experiment Station, spoke of the future possibilities in the aircraft industry, and some of the problems that will have to be met. This topic is being given much thought and discussion today. It is the belief of one faction that after the war there will be a plane in every household within a period of a few years and that the family car, railroads, trucking systems, and bus lines will be a thing of the past. Gigantic airplanes filled with freight and with those having business in the next country will cloud the skies, and after the day's work is done, Dad will merely hop into the plane, fly to the mountains and enjoy a nice quiet evening of fishing on his favorite lake.

The speaker, however, gave a more "down to earth" view of the future of aviation. He attacked these optimisms one by one and presented logical arguments backed with figures in answer to them.

As for the possibility of everyone owning and flying his own plane, the average citizen is not capable, either physically or mentally, of learning to operate a plane with the ease, dexterity, and safety with which he has mastered the automobile. It is the speakers' opinion that the efficiency of our airplanes will have to be increased far above their present-day figures if they are to very seriously compete with the railroads, which can move a hundred car train with only one engine, on an economical basis. Probably the most tangible problem in connection with the coming of a vast aviation expansion is the problem of landing fields and maintenance equipment. Although it takes a relatively short time to get from Cleveland to Chicago, for example, it takes

(Continued on Page 16)

. . . engineered at Western Electric

In a split second this enemy plane will be blasted from the skies by a shell from one of our anti-aircraft guns.

How is it possible? Just think of the mathematical problems involved in hitting a plane going 300 miles an hour 20.000 feet up . . . when it takes the shell 15 seconds to get up there and in that time the plane has gone more than a mile! Besides, the shell curves in its flight. Wind blows it. Gravity pulls on it. Even the weather affects its velocity.

The greatest mathematician could never solve these problems in time to hit the plane. But engineers at Bell Telephone Laboratories and Western Electric have designed and produced a Gun Director—*an electrical brain*—that solves them instantly!

It plots the plane's height and course—continuously matches the curved path of the shell to the path of the plane so the two will meet. It aims the guns—even times the fuse to explode the shell at the exact instant.

Putting the 3300 parts of this electrical brain into production called for the development at Western Electric of many special tools, machines and manufacturing methods. Mechanical, electrical and industrial engineers cooperated with chemical and radio engineers in this work.

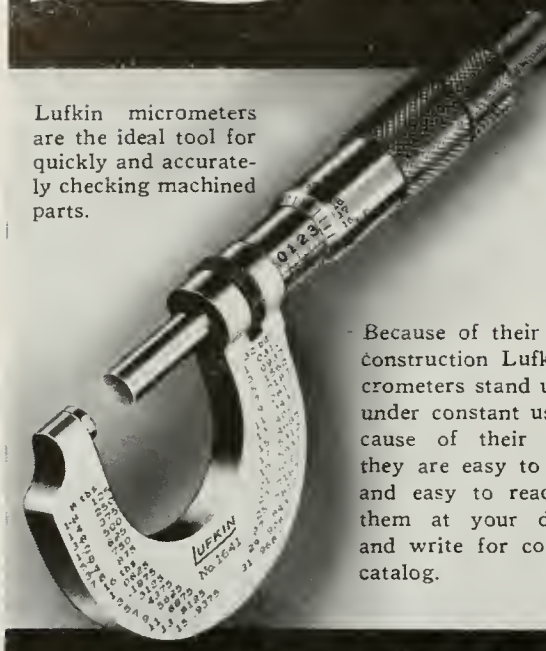
Making the *electrical* Gun Director is just one of many interesting assignments in Western Electric's vast war production job.

Till the last enemy plane is knocked down, buy all the War Bonds you can!

Western Electric

IN PEACE...SOURCE OF SUPPLY FOR THE BELL SYSTEM.
IN WAR...ARSENAL OF COMMUNICATIONS EQUIPMENT.

LUFKIN MICROMETERS



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Because of their sturdy construction Lufkin micrometers stand up well under constant use. Because of their design they are easy to adjust and easy to read. See them at your dealer's and write for complete catalog.

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TAPES · RULES · PRECISION TOOLS

(Continued from Page 14)

as long to get from downtown Cleveland proper from the airport, as it did to make the trip between the two cities, and since the airports will have to be on the edge of a town where there is sufficient room to maneuver a plane for a landing, provision will have to be made for the efficient handling of passengers and freight at the air-depot itself. Though this problem may seem rather small in comparison with others which arise, it is a typical example of the "bugs" which show themselves when serious thought is given to the prediction of aviation expansion.

These are only a few of the problems reviewed by Professor Fahnestock. Following the formal part of the address, a discussion period was held at which time the various students and faculty members present brought up questions which had arisen in their minds and were of interest to them.

Technocracked

Hardboiled Captain: "Your name?"
ASTP: "Jones, sir."
Captain: "Your age?"
ASTP: "Twenty-four, sir."
Cap: "Your rank?"
ASTP: "I know it, sir."

* * * *

Lew: "Do you know who was the greatest gambler that ever lived?"
Ed: "No, who was it?"
Lew: "Lady Godiva. She put everything she had on a horse."

* * * *

And then there's the one about the Scotsman who called up his sweetheart to find out what night she was free.

* * * *

Soph: "You're not living at the same boarding house any more, are you?"
Frosh: "No, I stayed five weeks and then found out they had no bathtub."

* * * *

And then there's the engineer who walked into a bar optimistically and walked out misty optically.

* * * *

1st P.E. Student: "How'd you come out with your jiu-jitsu lesson yesterday?"
2nd: "Swell! I surprised the instructor. I jumps at him like this, twists his arm like this, grabs him by the neck like this and before he knew what hit him—I was flat on my back."

* * * *

David: "I can't see what keeps girls from freezing."
Elly: "You're not supposed to."

* * * *

Mary had a little lamb
She tied it to a heater
Every time he turned around
He burned his little seater

* * * *

Rosie and Gertie were working in a Defense Industry.
Gertie to Rosie: "Know what I'm doing now, Rosie?"
"No, what?"
"I'm working in inspection using a micrometer."
"What's them?"
"Oh, you use them to measure things with. I'm measuring to one ten thousandth of an inch."
"Gee, that's close. How many ten thousandths in an inch?"
"I don't know, but there must be millions."

OPEN LETTER TO THE FACULTY & STUDENTS OF ILLINOIS:

The Welcome Side of the White Line's Door Mat is just aching to have you step on it by using our many services — all good — for 25 years we have been inspired toward a better Laundry and Dry Cleaning institution by living in the shadow of this truly great University. May we serve you, too?

WHITE LINE SERVICES

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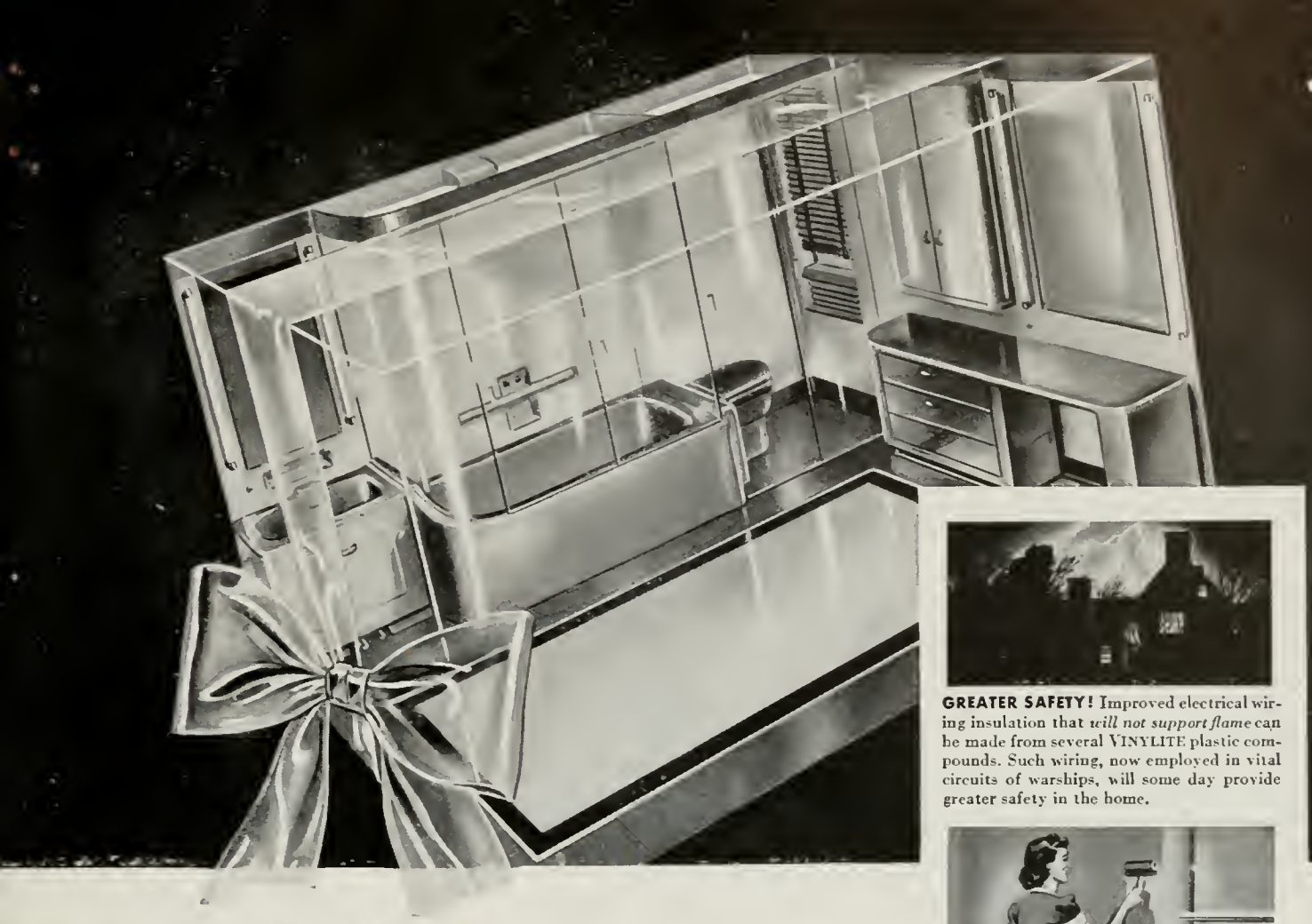

GREATER SAFETY! Improved electrical wiring insulation that *will not support flame* can be made from several VINYLITE plastic compounds. Such wiring, now employed in vital circuits of warships, will some day provide greater safety in the home.

MORE BEAUTY! New *washable* water paints based on BAKELITE resins, will bring new beauty to homes. These paints are inexpensive . . . and *easy to apply!*

LESS EXPENSE! Use of BAKELITE molding plastics in making washing machines, refrigerators, and many other household devices and fixtures can mean lower-priced, longer-lasting equipment for you.

LESS WORK! Easier cleaning of plastic-treated walls, ceilings, and floors. Plastic furniture and upholstery that are easier to keep clean. Yours in the future!

Plastics Will Mean Better Homes

. . . *and more of them!*

EVEN TODAY, plastics men can vision a bathroom with practically everything in it made of plastics or containing plastics in some form. Imagine such a bathroom, costing less to manufacture, to ship, and to install, delivered *as a unit* to your home!

The raw materials to make better homes with more bathrooms and finer kitchens come true are *in existence today* . . . in VINYLITE and BAKELITE resins, and plastics made from them.

BAKELITE resin-bonded plywood, like that from which planes and torpedo boats are made, can be used to make floors, walls, ceilings, and furniture.

The type of plastic film used in waterproof, chemical-resistant food bags and rifle covers can be fabricated into mildew-proof shower curtains. VINYLITE resins can also be made into rot-resistant floor coverings that can be walked on millions of times *without showing appreciable wear!*

Our engineers know from the record of VINYLITE plastic-coated life raft sails, sleeping bags, and life preservers, that VINYLITE plastics and compounds can be used in the future to bring you wall coverings, window curtains, and furniture finishes that will outlast anything now available.

Under heat and pressure, VINYLITE and BAKELITE plastics can be molded into numberless useful forms. Experience gained in molding war equipment will help to bring you such things as molded plastic furniture which will be lighter, easier to move, easier to keep clean!

Spun plastics made from vinyl resins are resistant to rot. Right now, such plastics are used for making jungle hammock ropes and vital chemical filters. They also can be fashioned into draperies, upholstery, stockings, and other articles of clothing ...sun-proof, water-proof, and moth-proof!

VINYLITE and BAKELITE resins and plastics, and many new techniques for using them, are peacetime research achievements of CARBIDE AND CARBON CHEMICALS CORPORATION and BAKELITE CORPORATION, both Units of UCC. Fabricators converting these raw materials into finished articles are making them mean more and more to you.

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JOE JENKS

Started Something

JOSEPH JENKS labored for immediate results rather than distant glory when he made the dies for America's first coin, the "pine tree shilling", but he did much more than that.

This is the 300th year for the clumsy, crude, cooking pot which Joe Jenks designed and pulled from his sand mold and which still exists, the prized possession of the Hudson family in Lynn, Massachusetts. That pot is the first iron product made in America. Of American iron, it is the first product of America's first successful blast furnace. It is a pot full of American firsts.

It was in 1644, on a bank of the Saugus river midway between Salem and Boston, in Massachusetts Bay Colony, that "a guy named Joe" produced this three pound pot that boiled over, in 1943, into more than one hundred million tons of steel, a single year's output of the world's largest enterprise, the American steel industry. Last year, the American iron and steel industry employed over 625,000 men and women, and, with these men and women, paid over $700,000,000 in taxes. These steel-workers, with the steel and taxes to make more steel, are a main reliance of those other men and women who, on foreign battle fronts, are giving all to preserve a way of life that is its own reward.

With understandable pride, The Harrisburg Steel Corporation, with over ninety years of know-how in steelmaking, is producing in ever-increasing volume products of war and will continue to produce in the coming days of peace seamless and drop forged steel products that include seamless steel cylinders, liquefiers, pump liners, couplings, drop forged steel flanges, coils and bends and other products to the specifications of customers who range from the smallest to the largest user.

★

HARRISBURG STEEL CORPORATION

HARRISBURG, PENNSYLVANIA

FIGHTING FORCES STANDARDIZE AIRFIELD LIGHTS

Airport marker lights used to mark airport boundaries, wind cones, runway approaches and airway obstructions — twelve kinds on all—are made by about twenty manufacturers. Formerly each manufacturer had his own design and each lamp was different, making it necessary for the Army and Navy to stock and assemble many parts. To simplify this, the two services have adopted a single standard marker light, consisting of several standardized parts from which any of the twelve different lamps can be made.

Each company's parts are interchangeable with those of another—even screw lengths are identical. Each part has but one function, so it is impossible to assemble a lamp to give an incorrect signal. Four types of light sources, 325 and 1020 lumen (series) together with 40 and 100 watt (multiple) have the same bulb, same base, and same light center. In accomplishing this standardization, Westinghouse engineers eliminated thirty-six parts.

EDITOR LEAVES

This issue sees the departure of the retiring editor, Harold Schick, who is graduating with the February class, and who is planning on attending the University of Minnesota. Jack Wilkinson, busy man on the editorial staff will be at the controls for the February issue.

The business manager, Chris Kacalieff, is also graduating this term, but will be on campus as a research assistant and will continue in his position.

Who was the cleverest inventor?

Edison. He invented the phonograph so that people would stay up all night to use his electric light bulbs.

* * *

"Here's one Luther Burbank didn't try," said the co-ed as she crossed her legs.

* * *

A new musical comedy came to town. The billboards read: "Fifty beautiful girls. Forty-five gorgeous costumes." Ten men were killed in the rush for tickets for the opening performance.

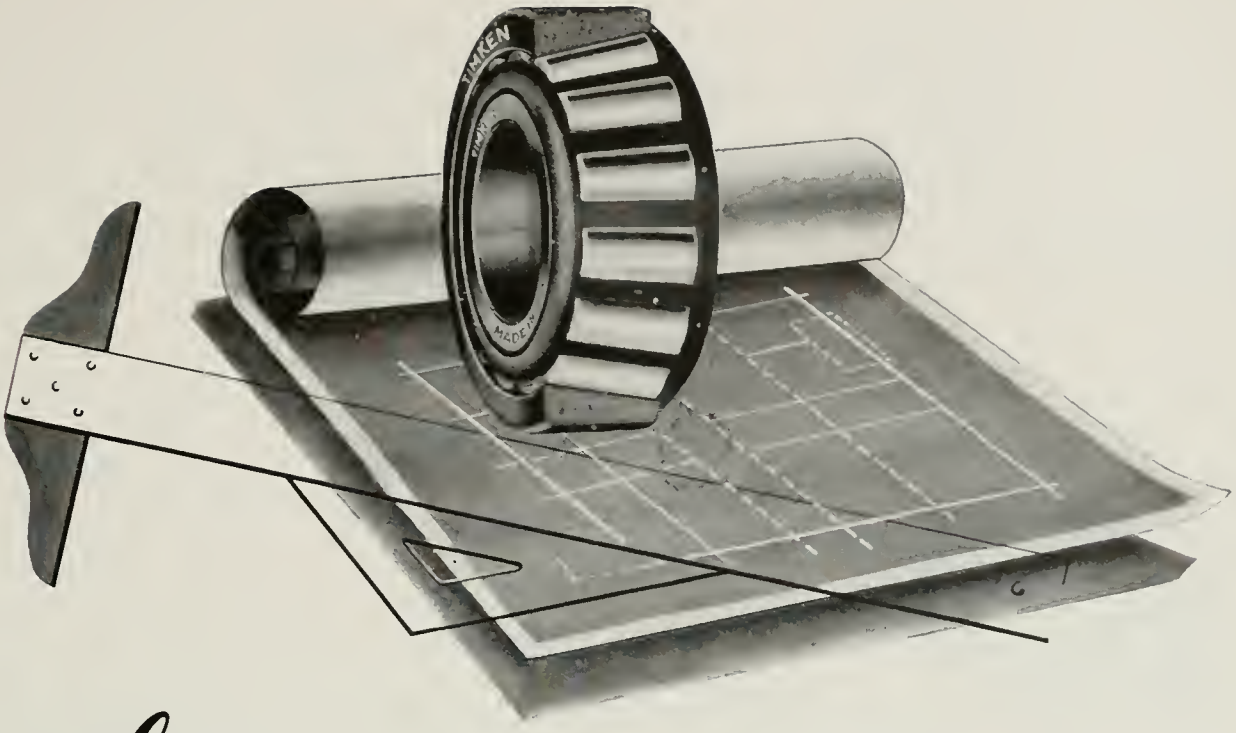
* * *

Doctor: "Have you any physical defects?"

Draftee: "Yessir. No guts."

* * *

Many an argument is sound — just sound.



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LEARN TO KNOW YOUR BEARINGS NOW

YOU may not get into this war, but there will be another tough struggle awaiting you when Victory has been won and the job of reconstruction begins. You probably will graduate right into the midst of the most severe competitive situation our country ever has known.

Then, as a full-fledged engineer, you will have the responsibility of keeping your company's products ahead of those of competitors by giving them greater speed, precision and endurance; lower operating and maintenance costs.

That's where your specialized knowledge of Timken Bearing design and application will pay dividends; for you will be in position to meet any and every bearing condition with complete protection against friction; radial, thrust and combined loads; and misalignment of moving parts.

Begin to acquire that knowledge now—while there still is time. Timken engineers will be glad to help you. The Timken Roller Bearing Company, Canton, Ohio.

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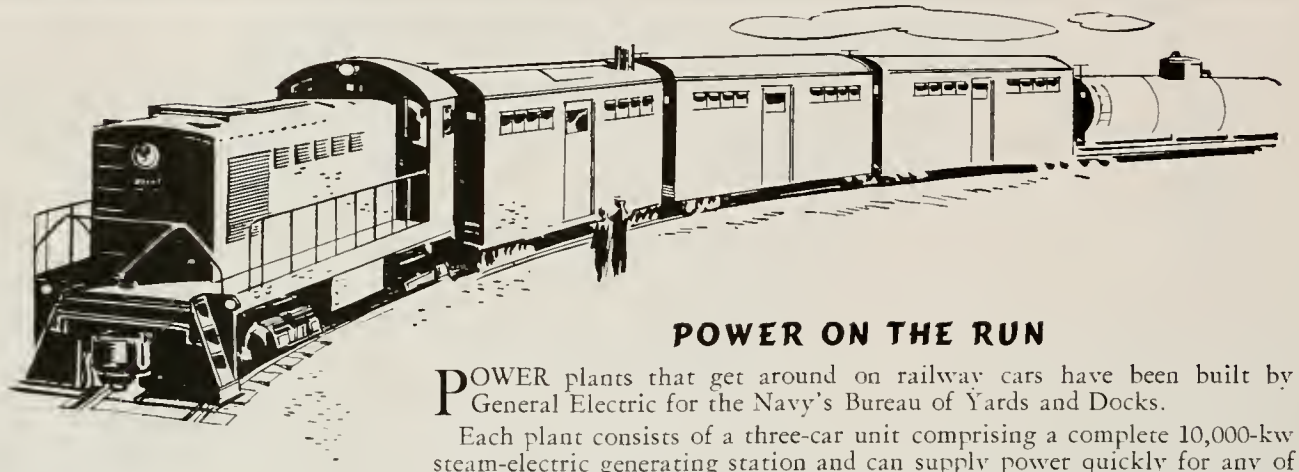
TAPERED ROLLER BEARINGS

Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD



POWER ON THE RUN

POWER plants that get around on railway cars have been built by General Electric for the Navy's Bureau of Yards and Docks.

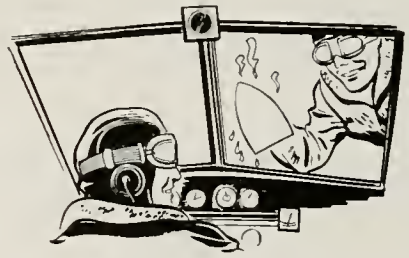
Each plant consists of a three-car unit comprising a complete 10,000-kw steam-electric generating station and can supply power quickly for any of the Bureau's many projects. Engineers estimate that these power plants can be "put on the line" within 24 hours after they are shunted on to a siding.

Although the units in themselves are unique, the apparatus involved is of the same type used in regular central station and industrial power plant installations throughout the country.

MACHINE OF MERCY

A HYBRID electric washer and water heater, devised by G-E workers, speeds and improves the Sister Kenny treatment of infantile paralysis. This treatment employs the application of hot damp packs to the patient to relieve pain and reduce muscular spasms, and the washer provides an improved way of heating and wringing the heavy woolen cloths used.

In the bottom of the tub, which does not have an agitator, is a Calrod immersion heating unit that can bring the water to a boiling point, permitting the use of the machine for contagious cases.



TEMP-TURB

A G-E engineer has ironed out the problem of temperature control and windshield defrosting in planes. His solution is an ingenious application of the bimetallic thermosensitive element used in automatic household irons.

This device, called the Temp-Turb, which regulates air temperatures for cabin warming and windshield defrosting, is now being installed in Havoc A-20 bombers.

The operation of the Temp-Turb requires no external source of power other than that obtained from the velocity of air flowing through it, on the windmill principle.

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC— "The World Today" news, every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

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192,000 employees of the General Electric Company are on their jobs producing war goods and buying over a million dollars of War Bonds every week to hasten victory.

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ILLINOIS TECHNOGRAPH

FEBRUARY
1944

★

NAVY SEABEES

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★

COVER . . . The Junior Prom Queen and Her Court

stablished 1885 Member E.C.M.A.

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When the lights go on again in Grigoriopol

Three short years ago Grigoriopol was a thriving city of the Russian Ukraine. Today it is a scene of desolation . . . victim of ravaging Hitlerite hordes.

But some day—soon we hope—lights will go on again in Grigoriopol, and in other Allied cities now under the Nazi heel.

When that time comes . . . thanks to a new idea in modern warfare . . . emergency electric power will be available to revitalize industries in war torn cities—immediately after they are retaken from the enemy.

This new idea—a self-contained POWER-TRAIN—has now been made a reality by the engineering brains and skill of Westinghouse.

Ten of these POWER-TRAINS are now being built by Westinghouse for use by the United Nations . . . each a complete 5000 kw power house on wheels, big enough to serve a community of 15,000.

Each POWER-TRAIN consists of 8 cars. Ingeniously assembled in these cars are: a 5000 kw steam turbo-generator, boilers, power stokers, boiler feed pumps, air-cooled condensers, auxiliary Diesel engine, living quarters for the crew—even conveyer equipment for handling coal which will be mined locally for fuel.

Because cooling water is not always available, air-cooled condensers are used to recover, as water, a high percentage of the exhaust steam from the turbine.

From switchgear to turbo-generator, each POWER-TRAIN is a complete 5000 kw mobile power house, ready to go to work at a few hours' notice . . . *in sub-zero cold or tropical heat of the desert.*

And remember—the same Westinghouse engineering brains and skill that developed the POWER-TRAIN will be available, after Victory, to create and build better products for you.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

Tune in John Charles Thomas, NBC, Sundays, 2:30 p.m., E.W.T.

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This Issue . . .

The Navy Seabees 7
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FRONTISPIECE . . . With the Seabees in the Aleutians. Unloading Lot. Curved sections in foreground are Pacific huts. Crane is unloading lumber from front of barge. Beach, with tents, in background. Official U. S. Navy Photograph.

THE TECHNOGRAPH

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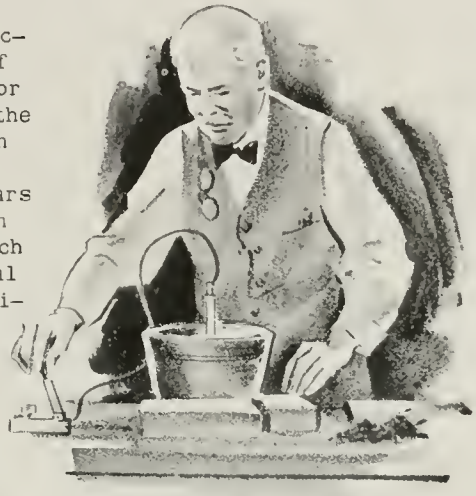

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The Navy . . .

SEABEES

By LT. W. K. TRIMBLE
C.E.C., U.S.N.R.

★

The Seabees receive training in landing tactics (Official Navy Photo)

The Seabees are a part of the Navy's Civil Engineer Corps, which, under the leadership of Vice Admiral Ben Moreel, administers the construction and maintenance of all naval shore establishments. Within the continental United States this work can be done by civilians, but in the theaters of operation, where bombing raids and sneak attacks by a desperate enemy are an ever present potentiality, it must be carried through by men trained and equipped not only to work but also, whenever the necessity arises, to defend their lives and the results of their labors. These are the Seabees—construction men in uniform, furnished with guns and grenades as well as with tools and equipment, and equally adept in the use of either.

There is no need of explaining the importance of shore bases to the fighting ships and aircraft of the fleet. Under the stress of battle, fuel, ammunition, and other supplies are rapidly expended, and must be replenished. Wounded personnel must be cared for, and damaged ships repaired. All of this must be done on shore, at bases staffed with trained personnel, stocked with supplies, and equipped with tools and machinery. The closer such support is to the actual scene of battle, the less time is lost in fulfilling these needs. Therefore the establishment of advance bases is equivalent to increasing the number of ships and aircraft available for combat operations.

Constructing a pile bent timber bridge (Official Navy Photo)

Providing these advance bases is the primary job of the Seabees. They build the Naval Air Bases which serve to bring air bombers and fighters ever closer to their targets. They build the fleet's fueling bases and machine shops. They work against time and under enemy bombs to unload ships of their essential cargoes. They build the roads, the utilities, the docks and wharfs, the warehouses, and all the other installations needed to support our fleet and air operations. They have also been trained to fight and to defend what they build.

Above all, the Seabees are a Naval organization. Much of their work consists of building advance base facilities for the fleet. But fleet installations nowadays mean air fields and hangars as well as piers and marine repair shops. The Navy's powerful air arm is striking hard . . . and its hidden nests are Seabee built.

The Naval Construction Battalions are among the youngest of all the branches of the armed services. A new organization, they had no storied tradition when they began less than two years ago, but they certainly have now. It's a rugged tradition of adaptability, technical skill, dogged determination, and flashing courage.

Two years ago, the Seabees' authorized strength was 3,300. Today the battalions are within close range of their new goal of 267,000 officers and men. Nearly half are already overseas; the remainder, now in training, soon will be on their way.

The men who built the Empire State building, who worked on the Golden Gate Bridge, who laid down the Pennsylvania Turnpike, the men who built skyscrapers, bridges, tunnels, roads, and public works of American—these are the men who enlisted in the Seabees.

Almost every Seabee is a specialist. In civilian life he may have been a superintendent, foreman, or head of his own construction company. He may have been a blacksmith, plumber, or electrician. He may have repaired automobiles, strung telephone wires, or driven a heavy truck. And in the Naval Construction Battalions he puts that skill to use in a vital military assignment. Each Seabee battalion has a place for men skilled in 59 necessary con-

A bulldozer clearing away tropical shrubbery from what will be a landing field a few days hence (Official Navy Photograph)

struction crafts and trades. The Seabees have what is probably a higher proportion of rated specialists than any other branch of the armed forces.

Included in the 1097 men in the typical Seabee battalion are 896 trained construction workers, organized into four companies of 224 men each, and 176 "headquarters" men—draftsmen, bakers, cooks, gunners, yeomen, storekeepers, barbers, mail clerks, etc.—who comprise a separate headquarters company.

The battalion's 32 officers include 26 Civil Engineer Corps officers, two doctors, a dentist, two Supply and Disbursing officers and a chaplain.

When two or more battalions operate in the same location they are formed into regiments and even brigades.

Seabee training is, to understate it, rigorous. Marine instructors school the construction men, most of whom already have been hardened by long years of outdoor work, to defend themselves against attack from any quarter.

Eight weeks after they pass through the gates of Camp Peary, Naval Construction Training Center at Williamsburg, Virginia, these men not only are ready to do a skilled building job, but also, if necessary, to fight shoulder-to-shoulder with the Marines and Army.

This initial training is almost entirely military. The men are assumed to be skilled technicians at the time they enter the Naval Construction Battalions. What they learn now is how to be top-flight fighting men as well.

Seabee recruits are drilled in the handling of rifles, carbines, machine guns and even the small field pieces. They receive instructions in the use of the machete, the wide-bladed sword with which Filipino fighting men split Jap skulls at Bataan. They are seasoned in the "kill or be killed" code of jungle fighting. When the Seabees depart for "Island X"—now legendary destination of all Seabee battalions—they are ready both to build and defend their advance base.

As the first Seabee-constructed bases swung into operation, existing native labor, plus whatever naval units could be spared from their regular duties, could not cope with the growing port and stevedoring problems involved in the quick, efficient unloading and dispatching of ever-increasing quantities of war material.

At one time, 66 cargo vessels were lying off a South Pacific Island, their valuable cargoes immobilized while hastily assembled unloading crews fell further and further behind. Meanwhile, despite all possible dispersal tactics, the ships were inviting targets for the Jap bombers overhead.

That was the situation when, a Seabee "Special" Battalion, trained in loading and unloading war material, arrived and quickly took over. Within a month the Special had emptied 31 vessels; today they are unloading ships as fast as they come in.

(Continued on Page 18)

"CANDID" CAMERA SHOOTS SIX FOOT NEGATIVES!

THE world's largest camera, developed and used by Bell Telephone Laboratories, makes negatives up to 6 feet high at the rate of 20,000 a month. The crew works inside the camera which has a battery of lenses with focal lengths to 70 inches.

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As one student to another

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Alcoa Aluminum probably means to you now just a whale of a lot of aluminum that is going into war tools.

But Alcoa, the company, is people.

And we have a long-time goal—a very human, peacetime goal we are saving in the hope of sharing with you. We would like you to think of us as Imagineers in aluminum, creators of employment and higher standards of living.

Alcoa is, first of all, a great collection of engineering knowledge based on experience that goes back to the birth of aluminum as a commercially available metal.

Then, it is imagination. It is the vision that sees aluminum, not as just another metal to sell but as a means of eliminating dead weight, or corrosion; as a means of reducing maintenance costs or increasing output.

The full significance of Alcoa can be summed up as experience in the application of aluminum to make more things available to more people. It's what we consider the only means of solving the perennial employment problem.

It requires constant inquiry. Constant study. Constant co-operation with every field of human effort that uses metal.

The results are as practical a way of bringing about a better world as any yet devised.

We hope, when we both return to the job of rebuilding the world, some of you will choose to do it with aluminum. That will mean, of course, with *Alcoa.*

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A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

The future of . . .

FIBER GLASS

By J. L. WILKINSON, Cer. E. '44

A comparitively new product of technical research and science is fiber glass. Although not very obvious the possible applications of fiber glass, especially in the field of insulation, are spectacular.

To illustrate the importance of thermal, electrical, and acoustical insulation it is only necessary to note the vast amounts being installed in warships, tanks and planes. Fiber glass is playing an increasingly important role as it's superiority to cork and asbestos, the two most widely accepted insulators in use today, comes to be realized.

The origin of glass fiber is lost in antiquity but the first hint as to the manufacture and use of such glass was discovered by archeologists in the examination of the ruins of Tell-el-Amarna, a flourishing little village about 2000 B. C.

According to archeological chemists the procedure for the making and forming of glass there was, more or less, as follows: sand was mixed with ground up alabaster or calcium carbonate and some sodium bicarbonate and melted. The molten glass was poured out into long narrow channels in clay bricks. When the glass became hard the sticks were extracted from the mold. This was glass fiber of a crude sort. When used, for example, in the construction of a vase, the canes were heated and softened and wrapped around a core of hard mud. The whole was then annealed until the vase walls became comparitively smooth and then the mud core was removed.

During the Renaissance period and earlier, Venetian glass blowers used glass fibers for executing intricate designs. His production methods, though simple, were considerably refined from those previously mentioned. When he had heated a lump of glass to the plastic state his apprentice siezed one corner with a pair of tongs and raced away as fast as he could run. Needless to say, this process was more picturesque than efficient but, nevertheless, fibrous glass was obtained. With the passage of time the Venetian developed a technique of gathering the fiber on a rapidly rotating wheel. These fibers were costly and the process tedious and their use was confined to novelties and toys.

Glass, as we know it today, still has the basic fundamental composition that it had 3000 years ago but we are able to control its properties by the addition of certain substances which were unknown to ancient man. In the first commercial processes, the glass batch was melted in an open hearth at a temperature of 2300°F. The molten mass was further refined, gravitated through orifices and drawn into fiber at a tremendous speed (about one and one-half times the speed of a rifle bullet). The long, flexible, interlacing fibers were then gathered on a continuous belt conveyor as a white, fluffy, resilient mass of predetermined thickness and density. The diameter of these first fibers ranged from 0.003 to 0.005 of an inch.

Today we are able to classify the various types of fibers. There are five basic fibers and these five are grouped under two headings: Thermal insulating wool, bonded mat fiber, and air filter fiber are classified as *wool fibers.* Continuous fiber and staple fiber are types of *textile fiber.*

In both the above processes glass marbles are fed into a small electrically heated furnace and are melted down. Textile fiber is produced when the molten glass flows by gravity through a row of fine holes in a metal die or bushing. In this manner a continuous filament is formed which is stretched into very fine strands and wound on a rapidly rotating drum.

Wool fiber, filaments four to eight inches long, is made by forcing the molten glass through the holes with high steam pressures.

Both types range as low as 0.0002 of an inch in diameter, about one fifteenth the size of a human hair.

Ordinary glass brittleness is replaced by resiliency and the tensile strength of such fiber becomes very large, 2,000,000 p. s. i. An electronic microscope photo micrograph at 50,000 diameters shows only smooth edges on the fibers. At 150,000 diameters the same smooth edge is revealed. The chemical and physical properties are such that this material, as an insulator, is efficient throughout the entire range of temperature from—112°F to 1000°F. Fiber glass is not affected by the action of any commonly encountered acids or atmospheric gases. The glass will not rot, it will not support combustion or bacterial growth, it is odorless and sterile. It remains unchanged in the presence of moisture. Properly installed fiber glass insulation retains these properties indefinitely.

Glass fibers lose some of their strength when braided and hence are not suitable for application involving severe flexing. Only after some 600°F has been reached does the fiber begin to lose its tensile strength; at 1500°F the fibers melt. Fiber glass yarns are two and one half times as heavy as cotton yarns but their durability is much greater.

From staple fibers cloth and tape are made. The fibers are first made into yarn and then woven into cloth using conventional textile machinery. Glass cloth is fire-proof, rot-proof, mildew-proof, stain-proof, and wrinkle-proof. Such a material lends itself readily to new applications.

Electrical wiring and coil insulation with glass is superior to silk or other organic materials and therefore the cross section of a wire may be smaller for a given current if glass insulation is used. Tests were run on a set of coils, exactly alike except for the insulation, to determine the extent of serviceability. The tests were so severe that the cotton and silk insulated coils burned out in thirty minutes but twenty nine hours later the glass insulated coils were still operating efficiently. This is only one example of the effectiveness of glass as compared with other materials.

For many years glass wool has held an established position in the field of thermal insulation for domestic and industrial use and its qualifications regarding this application need not be discussed.

Not many years ago an author, writing a history of glass, included a short paragraph dismissing fiber glass as a passing fancy of the Venetian glass blowers. Little did he realize the myriad of uses that would one day be found for it.

Swimming Pools ar

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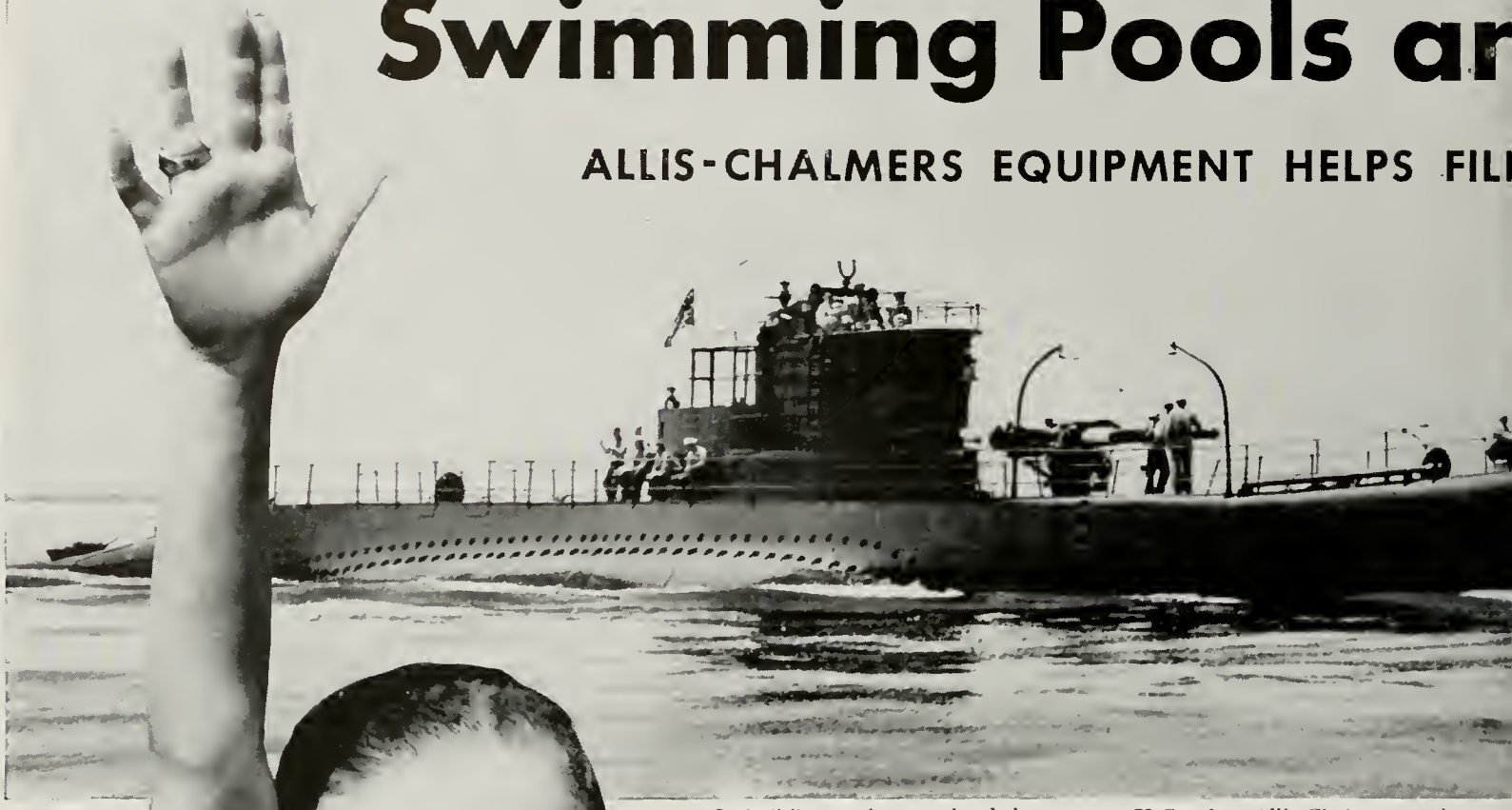

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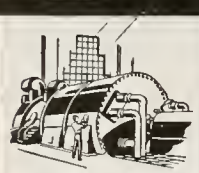

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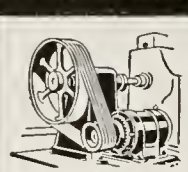

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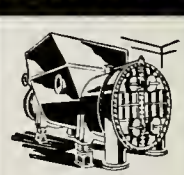

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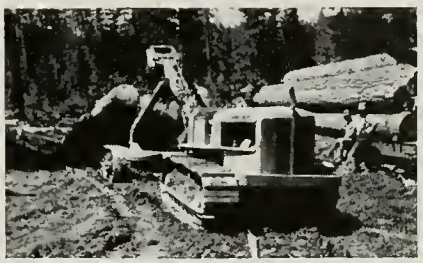

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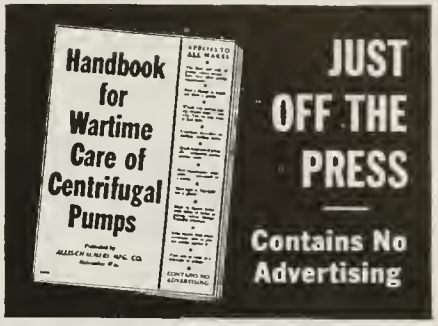
VICTORY NEWS

Converted Carriers Aid Navy! Official Navy Photos reveal that merchant vessels are rapidly being converted into auxiliary-aircraft escort ships to protect convoys from subs and bombers. On some ships already converted a great variety of A-C equipment has been installed—including main propulsion turbines, auxiliary generating sets, condensers, centrifugal pumps, motors and control.



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New "Electro-Cooler"! Vitally needed increases in power transformer capacities can now be obtained quickly with a new system of forced-oil cooling that saves 25% in critical war materials on new transformers.

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Gold Star Engineers

Since the War began in December of 1941 many brave Illini have gone to battle against the common enemy of democracy and the American way of life. The tempo of the War has been ever increasing in crescendo as the Allies have thrown off their protecting cloaks of defense and donned new and stronger battle dress — offense. These powerfully aggressive actions have caused the Axis nations to begin to tremble and lose faith in their leaders. Spearheading the great offensive in both production and combat has been the role of the American people.

The University of Illinois has given of its greatest men to the conflict. All have gone into battle imbued with the spirit of the fighting Illini, a few have not returned. It is these men to whom we wish to pay tribute. Their gallantry and valor in the face of the enemy is unsurpassed and we who remain stand humbly in their memory.

The Gold Star heroes on the opposite page are all engineers, alumni of the U. of I. This group of men is but the lesser number of those engineers who have given their lives in the defense of their country. Many more, with different names, but struck with the same high ideals and courage have gone with them to their deaths.

Every engineer, every alumnus of the U. of I., has pledged himself to avenge the death of those who have gone before him and they may rest untroubled in the assurance that the day of victory will come and that they have not died in vain.

Ens. D. H. Anderson '43

Lt. R. K. Babbitt '40

R. P. Chenoweth '40

Lt. V. H. Evans '42

Capt. R. M. Faris '32

Lt. H. W. Fraser '39

Ens. A. Masley '44

Lt. Leo Malkin '41

Alfred S. Pearsall '46

Capt. A. K. Porter '37

Lt. L. M. Shimeall '39

Capt. J. M. Simpson '18

Lt. F. L. Stephenson '40

Lt. Marcus M. Sur '42

Capt. C. H. Webb, Jr. '38

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Highway Conference

The Thirty-first Annual Conference on Highway Engineering sponsored by the Department of Civil Engineering was held on campus February 16-18.

The crux of the conference lies in the following excerpt from the program. "For the third time since war was thrust upon us this Conference is convening. Two years ago our thoughts were turned to putting our highways to war service. A year ago the problems related to "keeping them rolling" and this has been done despite many difficulties.

"Today these new problems are undiminished and in addition new ones loom before us. When hostilities cease we must be ready for a highway program that will far exceed anything that has gone before. Not merely must the ravages of war be repaired but our entire highway system must be overhauled, enlarged, and improved to meet the new traffic demands that inevitably will be placed upon it.

"The knowledge and experience gained in times of peace have enabled war construction to be done with a speed and effectiveness little short of miraculous. The added experiences and developments resulting from the war will be of inestimable value in the new peacetime program which will be of a magnitude and to far higher standards than ever before. *Now* is the time to start to prepare for the huge tasks before us."

With this in mind the road engineers convened. The opening address was given by Dean M. L. Enger after which a business meeting was held. On the following days the men were entertained by leading men who presented lectures, movies and slides of topics pertinent to the business at hand. The conference was under the able direction of Prof. C. C. Wiley.

I. Aroztegui, architect of Montevideo, Uruguay, and at present a post-graduate student at the *University of Illinois*, is shown above before the cameras of WRGB, General Electric's television station explaining his plans for the "television studio of tomorrow" which won him an award in the contest conducted by the Beaux-Arts Institute of Design. Also included on the broadcast were the two other award winners, Miss Trevy Wilcox and Miss Helen Ross of the University of Pennsylvania.

And then there's the one about the butcher who backed into a meat grinder and got a little behind in his orders.

Rx ...for Rusty Roofs

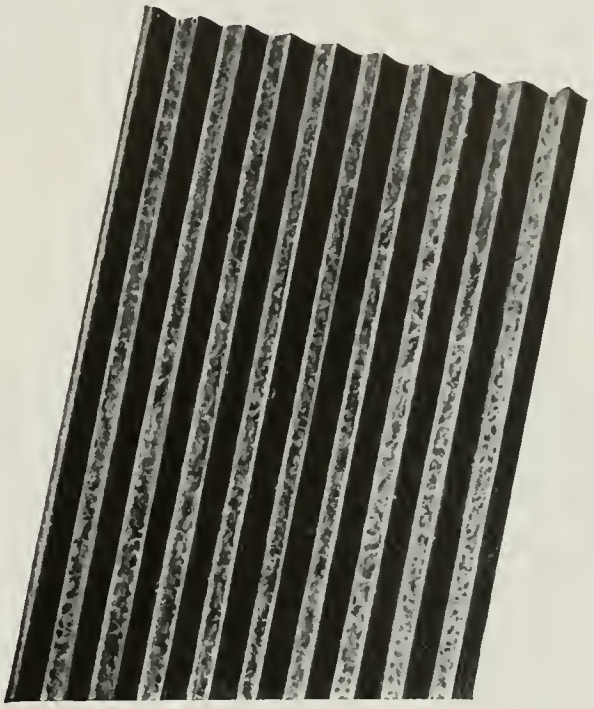
Here is a sure remedy to renew the utility and appearance of galvanized roofing sheets that show a tendency to rust:

Apply . . .

METALLIC ZINC PAINT

This truly remarkable paint has proved its worth in many a practical test. The rust-inhibitive and preventive power which Zinc possesses as a coating on galvanized sheets is carried into the paint itself through the metallic Zinc dust in the pigment. METALLIC ZINC PAINT applied to metal roofing sheets at the first sign of rust will completely stop it for many years—the durability of the paint is amazing.

For best results, follow the formula in Federal Spec. TT-P-641 as prepared by the U. S. Bureau of Standards.



BUILDINGS

Are Important In Food Production

Our country will be called upon in 1944 for the greatest food production in history. Industry as well as agriculture has its duty to perform in the great "Food Fights For Freedom" program. Many buildings, both on farms and in industrial areas, are used for food storage and processing, and the maintenance of these buildings so as to provide safe and adequate storage and shelter is highly important.

KEEP YOUR WAR EQUIPMENT FIT AND FIGHTING — FOOD FIGHTS for freedom

Buildings Are War Equipment Keep Them Fit and Fighting

How to Make GALVANIZED ROOFING Last Longer

As part of its contribution to the campaign for conservation of materials and to the "Food Fights For Freedom" Program, the Zinc Institute has prepared two booklets of special value to anyone who desires to maintain the utility and appearance of galvanized roofing practically indefinitely:

1-"METALLIC ZINC PAINT"

2-"HOW TO MAKE GALVANIZED ROOFING LAST LONGER"

These booklets are being distributed free, and a postal request will bring copies to you.

AMERICAN ZINC INSTITUTE
INCORPORATED
60 East 42nd Street • New York 17, N. Y

(Continued from Page 8)

Although many of the men in the Special Battalions had no cargo experience prior to joining the Seabees, careful training and an enthusiasm for their work have made these crews a match for professional longshoremen at home.

The Seabee stevedores and longshoremen learn their trade in a unique training school at Camp Peary. Their "classrooms" are two land-built training ships, complete with all Liberty ship gear.

The Seabees are also involved in what so far appears to have been one of the war's "best kept secrets". "Ranger" and "Commando" are familiar terms in almost every American household. The public knows how these fearless assault units spearhead Allied invasion. But somehow the spot-light has missed a group of men who often go into action even before these handpicked forces.

The terrifically dangerous job of removing obstacles to landing operations, whether they are above water or below, before shock troops hit the beach, has been assigned to Seabee demolition units. The Seabee demolition men are all volunteers for this hazardous assignment. Working in groups of five—four enlisted men and an officer—they steal ashore in advance of the first assault to blast or otherwise clear the way for the ships and men to come.

The work of the Seabee demolition units is essential to offensive operations. They did their job at Salerno; they will be in the forefront of still bigger invasions to come.

Almost every Marine division has a Seabee detachment with it. Wearing Marine uniforms and standing shoulder-to-shoulder with the leather-necks when the initial assault is launched, the Navy's hard-hitting construction force often moves in under heavy enemy fire to help take over the sites on which advance base construction will immediately begin. A Seabee battalion which continued its work on Guadalcanal while taking all the Japs could throw at it received a Presidential Citation for its remarkable record.

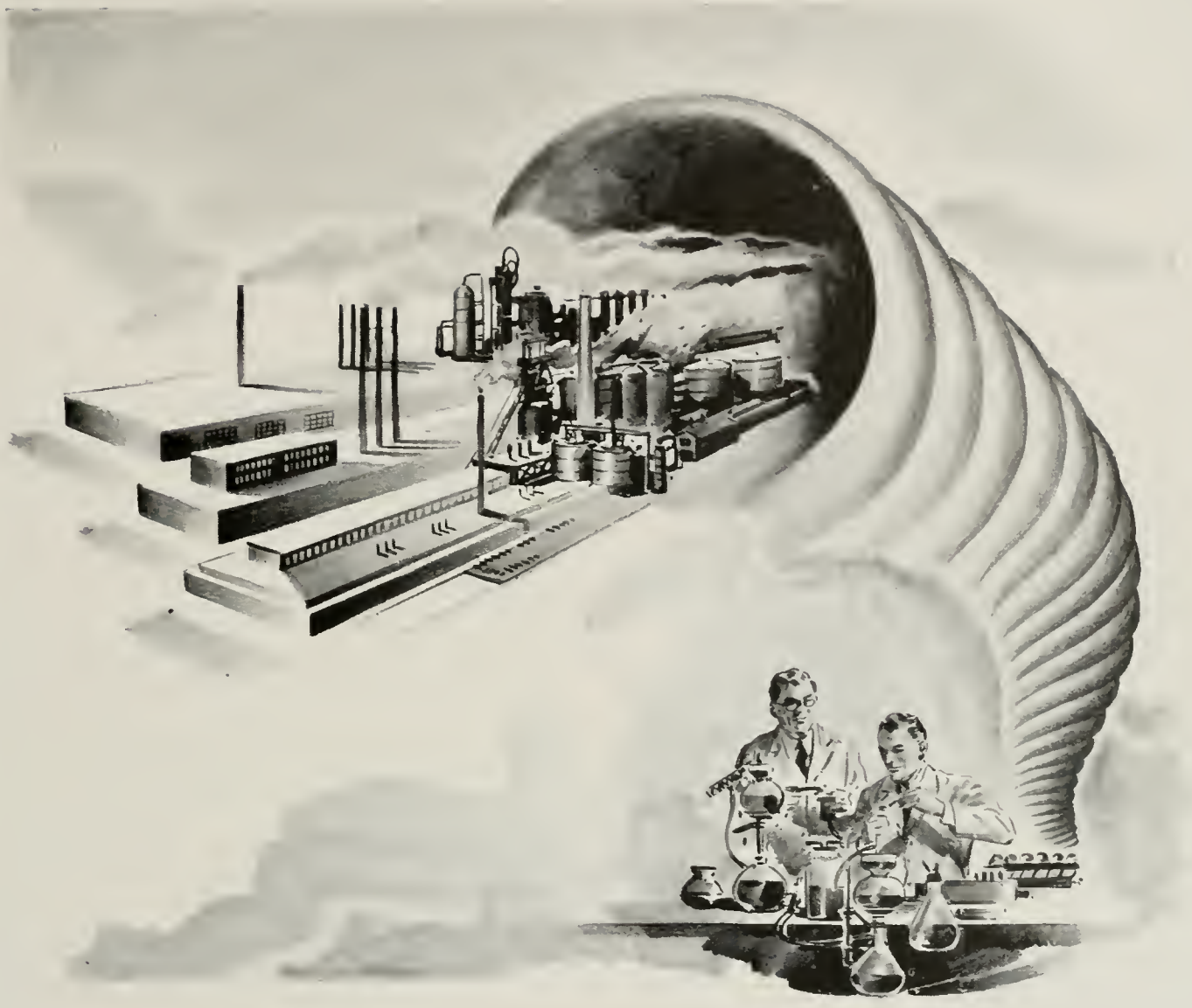
Still another specialized cog in the Seabee organization is the Construction Base Maintenance Unit. Each Base Maintenance Unit numbers 270 men and 5 officers. Its function is to take over the maintenance of an advance base already in operation, thus freeing an entire battalion for further new construction.

New construction means another "Island X". And for a Naval Construction Battalion, the destination may be anywhere—a pinspeck atoll in the South Pacific; a barren ice-bound island in the Aleutians; a mine-strewn beach in Italy; perhaps a teeming seaport in India. For one of the first Seabee Battalions, "Island X" materialized as a tropical hell-hole that newspaper readers later identified on page one maps as Guadalcanal . . . "X" marks Henderson Field.

Henderson Field, started by the Japs but taken over by the Seabees, and completed against a background of continuous Japanese air assault, was one of the first and perhaps the most famous project to bear the Seabee trademark. There have been many others since . . . air fields, docks, fortifications, military installations of almost every description . . . some already in operation for many

(Continued on Page 20)

Sheeps-foot rollers compact the earth for a smooth, level runway (Official Navy Photo)



Chemistry and Industrial Evolution

Industry has been free to use its own resources for new developments—to engage in research—to examine, reject or adopt new ideas. Commonplace necessities which do not lend themselves to fundamental change are improved by new production methods and the use of new materials. This freedom of action has kept industry from becoming static.

Industrial chemistry is more susceptible to this evolutionary process than perhaps any other enterprise. By developing new materials, test tubes generate fresh energy for the advancement of industry at large. From these materials, new products often evolve. There is no stronger testimony to the place of chemistry in this process than the more than 500 products produced by Dow—chemicals indispensable to Industry and Victory.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • Philadelphia • Washington • Boston • Cleveland • Chicago • St. Louis
Houston • San Francisco • Los Angeles • Seattle

DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND VICTORY

(Continued from Page 18)

months but closely guarded military secrets; others just under way in jungles where dead Japs, still unburied, comprise a grim and thoroughly unappreciative audience.

Seabee construction is basically a behind-the-scenes affair. But these tough-muscled builders are ready to fight when they have to . . . and they really pack a wallop. A Marine who is a veteran of several overseas campaigns wasn't fooling when he said to a newly-enlisted Seabee, "Brother, you sure picked yourself a rugged outfit."

In the Solomons when the Marines, short of men, temporarily had to evacuate a section of the front line, they asked the Seabees to take over . . . and the battling builders held on for three days and nights. At Salerno, when the first shock troops waded in to the beach, Seabee demolition units already had exploded their charges in the face of enemy fire, and other Seabees were standing up before merciless shelling and strafing to unload more than 10,000 pieces of equipment from the invasion craft constantly coming in. At Rendova a Seabee detachment was on the beach with the first assault wave. In the Aleutians and in North Africa, men from the Naval Construction Battalions were in at the beginning of the show.

Yet the real story of the Seabees is told not so much in battle as in work, sacrifice, and ingenuity. It takes tremendous courage to reach and hold the high emotional peak with which a soldier goes over the top; it takes another equally real kind of courage to plug along for a year or more at a stretch in a disease infected jungle or a storm-ridden Aleutian wasteland, braving snipers' bullets, shells, and bombs—one battalion worked through 238 bombings in 240 days and nights—and still retained the dogged determination to get the job done as quickly and as well as possible—come what may.

Perhaps, after this war, it will be possible to tell more about the specific installations the Seabees are now rushing to completion . . . and when it is told, these courageous builders will come in for their share of glory. But fight now, pounding pulverized coral into a smooth, safe air strip on some outlying island way-station may be an unappreciated job—unappreciated until that air field becomes the jumping off place for tomorrow's headlines.

The Advance Bases constructed by the Navy Construction Battalions generally fall into two categories—those for the support of ships and those for the support of aircraft. One of the larger Advance Bases, already established, has a capacity equal to some of our smaller continental Navy Yards. Such a Base is capable of handling voyage repairs and minor battle damage repairs on all classes of Naval vessels, including submarines.

Ship repair bases are usually provided with floating dry docks for under-water repairs. These are available in a range of sizes from the 100,000-ton Advance Base Section Dock to the small pontoon dry docks of 100-ton capacity for PT boats.

By far the largest construction job at Advance Bases, is the preparation of airfields for fighters and bombers. In extensive areas of the South Pacific Islands coral is available for surfacing these fields and sometimes it is found in place at a depth of less than two feet below the present surface. In these cases, it has, therefore, been possible to surface the fields entirely with local materials.

More frequently, however, it is necessary to surface the finished grade with either asphalt, stabilized soil or steel landing mat. The speed of laying the steel mat (a field of 130 feet wide by 6000 feet long in 48 hours, with 100 men per shift) is vastly greater than the best speed obtainable with stabilized soil. The only danger is that too much will be expected of the steel mat and the subgrade will not be properly consolidated and leveled off. The steel mat is purposely made flexible and a bearing power of the soil of at least four tons per sq. ft. is necessary to maintain a permanently smooth steel plank surface. It has been proven possible in emergencies to provide landing fields even for bombers laying the mat directly on a soil of less than one ton per sq. ft. bearing power. These fields generally require consolidation by working gravel through the holes in the mat, or as was done at one field—rolling the mat back, scraping out the soft material and putting in gravel.

In order to reduce the consumption of critical materials and demands upon shipping, the general policy, given below, is followed in the construction of Advance Bases:

(a) Construction is temporary and the extent of construction limited to essentials only.

(b) As much material as practicable is obtained in the vicinity of the new bases.

(c) When practicable, labor, except skilled supervision, is obtained locally.

(d) Mechanical equipment furnished is limited to the bare essentials.

The Construction Battalions have been successful in doing all classes of work called for in connection with the building of Advance Bases from Iceland to New Georgia. They are not used in continental United States, except for purposes of training or in emergencies.

Possibly the best criterion of the work of the Seabees is the opinion of the men who are in position to know the facts. A few such opinions are cited: In a letter to Admiral Moreell, Chester W. Nimitz, Admiral of the U. S. Pacific Fleet, on October 5, 1943, wrote: "Once again I cannot too strongly emphasize the appreciation which we all feel for the vigorous, cooperative, and imaginative way in which you and your Corps are helping us in this Pacific war. The Seabees continue to distinguish themselves wherever they may be found throughout the Pacific Ocean areas, as do also your officers of the Civil Engineers Corps."

Lieutenant General A. A. Vandegrift, Commandant of the Marines had this to say: "I wish to commend the wisdom that foresaw the need for such an organization. In the war in the Pacific in seizing one base after another, few of us realized the great amount of construction which would be necessary. I do not know how we would have gotten along without the Seabees and trust that they will be participants in every future operation in even larger numbers than at Guadalcanal."

Captain Edward V. Rickenbacker has this to say: "It has been my good fortune to see, and associate myself with, the Seabee units of the Navy throughout the Pacific. Without a doubt they are proving themselves one of the most important units of our Military Forces in this life and death struggle throughout the world."

In my opinion the extraordinary success of the Seabees has been due to two principle factors: First, the men continue to do the same work that they did before they enlisted in the Navy, and second, they are bossed by officers who know construction and speak the same language as the men.

The purpose of this brief article has been to give you a general idea of the activities of the Navy's Construction Battalions. Their accomplishments during their brief life of only two years have been found worthy of commendation by all ranks, from Marine privates to commanding generals and admirals. More and more frequently, the word "Seabees" crops out in news dispatches as fresh invasions and advances are launched. With United Nations now definitely on the offensive, the frequency of these stories can be expected to increase. I hope you will read them with pride, for these are American engineers and construction men, men of your kind, who are making an outstanding contribution toward that final victory for which we are all striving.

(This article was presented as a speech before the Conference on Highway Engineering—Editor)

Zone of Progress

IN AN AGE of progress in many fields, no advances have been more helpful to man than those made in medicine and surgery.

One of the forces that has made it possible for this progress to be rapid is synthetic organic chemistry. This science has provided those who manufacture pharmaceuticals with means of obtaining many new chemical materials from which to produce new chemical combinations. Synthetic organic chemicals are priceless raw materials in the eternal fight for health.

Through the use of synthetic organic chemicals, many anesthetics have been developed. The number of these anesthetics is of great value, since the physician can choose one suited to the patient's needs. This means less shock and greater comfort for the patient, thus often contributing to his swifter recovery.

Many other pharmaceuticals are made with the help of synthetic organic chemicals. Anti-malarial substances, synthetic adrenalin, man-made vitamins, anti-pyretics (to cut down fever), many kinds of sedatives, vehicles in which drugs are administered, and solvents used in extracting drugs from natural sources are some of the medicinal aids made possible by these chemicals.

CARBIDE AND CARBON CHEMICALS CORPORATION, the Unit of UCC which pioneered in the field of synthetic organic chemistry, has made more than 160 synthetic organic chemicals available in commercial quantities. Many of these chemicals are important in various ways in the pharmaceutical industry.

Pharmaceutical manufacturers, and research and technical men in chemical and allied industries, are invited to send for a copy of the 100-page booklet P-2, "Synthetic Organic Chemicals," which technically describes the properties and some of the uses of these chemicals in pharmaceutical and other fields.

BUY UNITED STATES WAR BONDS AND STAMPS

SAVINGS FOR YOU! Synthetic chemicals in tank-car quantities serve as solvents and raw materials throughout industry to make more and better things at less cost to you.

COLD-PROOF! Coolant for liquid-cooled aircraft engines and base for anti-freeze in military cars and trucks is ethylene glycol, an important synthetic chemical.

MAGIC PLASTICS! Wonderful plastics that look like glass, stretch like rubber, and which are proof against water, sunlight, oils, and many chemicals are made from VINYLITE synthetic resins.

MAN-MADE! All types of synthetic rubber require synthetic organic chemicals for their manufacture. Here's hope for tires for you in the future.

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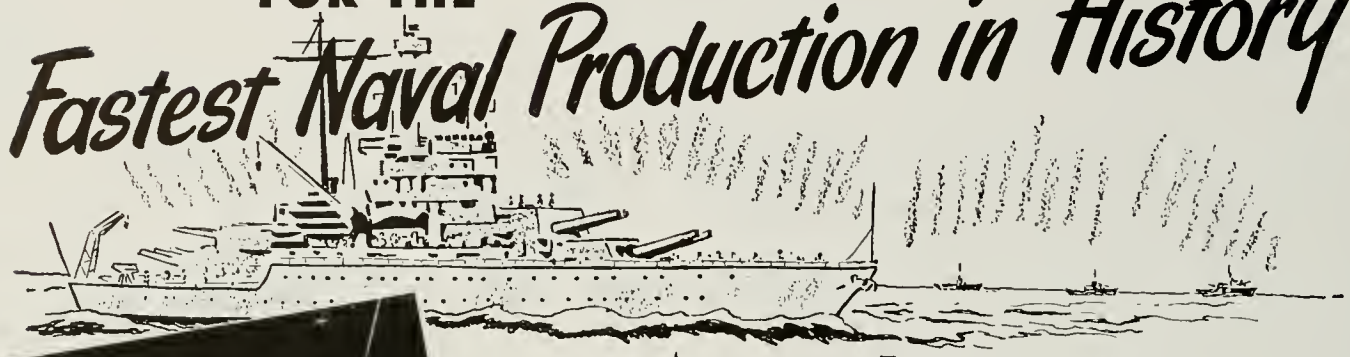
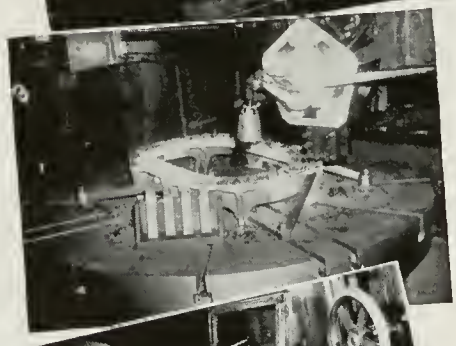
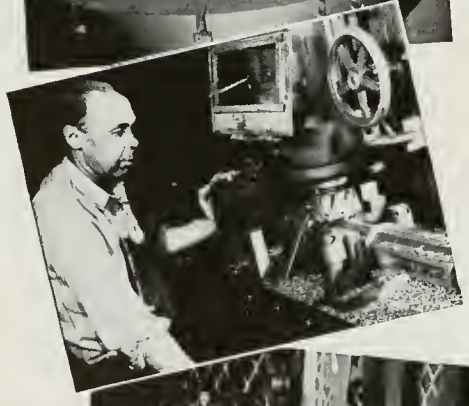
CUTTING THE STEELS OF WAR

FOR THE Fastest Naval Production in History







OFFICIAL U S NAVY PHOTO

★

In Industry! Typical of the way carbides are helping to speed production of hundreds of parts in industry for naval use is this job of machining cast steel pinion bearings for main drives of destroyers. Cutting at 220 feet per minute, Carboloy tools reduce machining time at least 25%.

★

In Navy Yards! In the Navy Yards, too, carbide tools are a vital factor in helping speed production. At Portsmouth Navy Yard, for example, Carboloy tools machine cast steel frames for watertight doors on submarines at speeds 100% faster than before. For this intermittent cutting job, Carboloy grade 78-C tools cut at 150-175 F.P.M., .032" feed, with varying depth of cut up to 3/16".

★

In Naval Ordnance Plants! Here again carbide tools have a job to do—and are doing it! Typical is the milling of steel breech casing at a midwestern U. S. Naval Ordnance Plant. Carboloy mills —operating at 650 S.F.P.M., 7 1/2" table travel—eliminate one milling machine and two grinders through faster operation and better finish obtained.

★

On the High Seas! When repairs are needed far from port—the Navy is prepared! "Floating" machine shops with modern, efficient equipment—including carbide tools—are a standard part of large Naval vessels.

IN U. S. Navy Yards, in Naval Ordnance plants, aboard naval vessels, and in all important plants of suppliers to our navy, you'll find carbide tools helping to speed up schedules—turning out the steels of war!

The ability of carbide tools to machine at high speeds, produce an unusually high quality of finish, reduce machine downtime, and cut heretofore non-machinable alloys, has been put to extremely good advantage by those charged with the responsibility for the greatest naval production in history.

★

EVERY facility of Carboloy Company has been made available to the U. S. Navy in an all-out program of cooperation. Carboloy representatives from coast to coast are on call whenever needed; Carboloy Training Films are at work helping speed naval training activities in the field; and the Carboloy Training Course at Detroit has trained, and is continuing to train, key navy men responsible for carbide tool use in naval production.

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IT'S MAN-MADE from metal and no bigger than a thimble, but at 30,000 feet this tiny mechanism means life to our pilots.

On stratosphere flights it is this vital part of the Airco regulator which automatically controls the proper flow of life-sustaining oxygen. As flight altitude increases, it instantly increases the oxygen ratio. Like the supercharger, it has helped to push up the effective ceiling at which our war-planes may operate . . . making war-planes more deadly . . . air transports faster and safer.

This high altitude oxygen regulator is just one of many Airco products which—in addition to Airco welding and cutting torches and Airco and Wilson arc welding equipment—are contributing to the advancement of American aviation.

Similarly in every major industry—from shipbuilding to food packing—Air Reduction products and processes are helping to establish faster and better manufacturing techniques to meet the need for more and sturdier war goods. If you would like to receive our informative publication "Airco in the News," we shall be glad to send a free copy. Write to Mr. G. Van Alstyne, Dept. C. P., Air Reduction, 60 East 42nd St., New York 17, N. Y.

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Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

TEST FLIGHT

TINY electric strain gages on the wing answer one of many plane-design problems. No bigger than a penny matchbox, these gages give on-the-spot readings that tell the engineers where to strengthen, where to lighten many of the plane members. Frequently, the readings on dials lead to a more efficient design technique and a desirable reduction in weight.

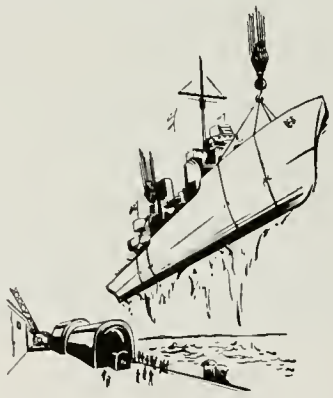
Armed with the General Electric strain gage, engineers can get the answer to ship, plane, and gun design problems quicker than ever before.

How deep can a submarine submerge? How big a firing charge will a gun stand? How great a load will a roll-bending machine take? The strain gage knows the answers.

BUBBLE-WELDING

"BUBBLE, bubble" takes the "toil and trouble" out of welding magnesium, the strong, lightweight metal derived—among other sources from sea water. Magnesium is so light that a grand piano made from it could be lifted by one man . . . so strong that its use in airplane construction is desirable.

General Electric has developed a technique for welding this metal inside a "bubble," an invisible one of non-inflammable helium gas surrounding the welding arc. By means of the bubble, nitrogen and oxygen—which would otherwise combine with the magnesium—are excluded, and the welding conditions brought under accurate control.



200 FEET A MINUTE—UP!

A DESTROYER *could* move that fast, in that direction, if the world's most powerful motor were lifting it.

This giant direct-current motor is one of the youngest in the General Electric family of motors. It was recently completed at the company's Schenectady plant, and has just been shipped to Geneva, Utah. It possesses a maximum of 4,100,000 pound-feet torque, thus developing more turning power than any other motor, either a-c or d-c, ever built.

At Geneva, it will be installed in the DPC plant which is operated by the Geneva Steel Company, and will help roll out steel for Navy ships.

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—
"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

GENERAL ELECTRIC

963-78-211

192,000 employees of the General Electric Company are on their jobs producing war goods and buying over a million dollars of War Bonds every week to hasten victory.

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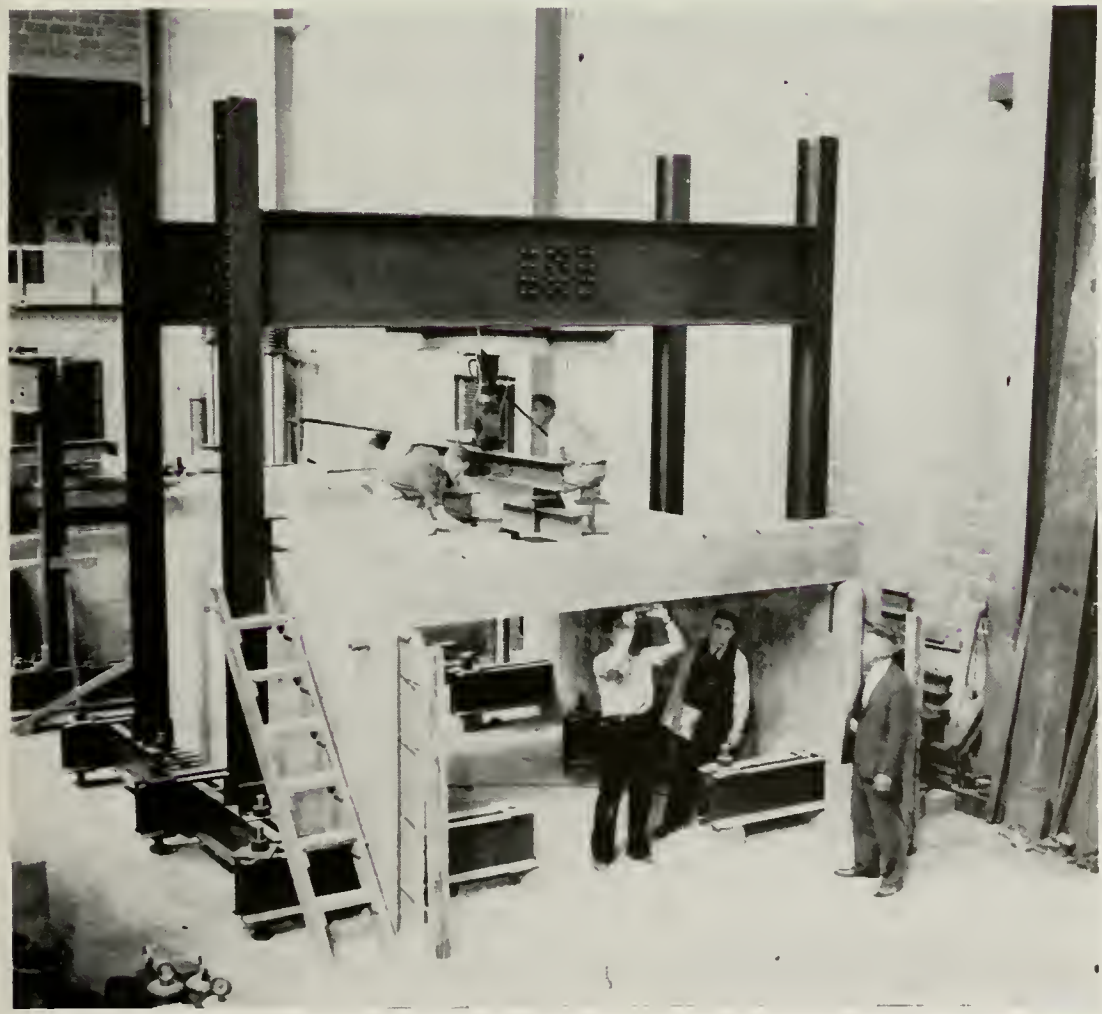
ILLINOIS TECHNOGRAPH



MARCH
1944

★

ELECTRONIC HEATING

AIRCRAFT PROPELLERS

NAMES IN THE NEWS

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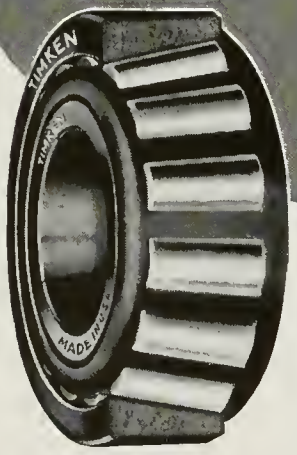


THE new world —the world of the post-war era — will be a world of wheels to a greater extent than ever before. The development of new kinds of production and transportation equipment, and the recreation of existing machines will greatly increase the necessity for and importance of bearings capable of meeting new conditions of speed, precision, load capacity and endurance.

Then the same bearings that have consistently and successfully anticipated so many revolutionary developments for more than three decades, again will rise to the occasion with the same versatility and efficiency — Timken Tapered Roller Bearings.

As a designing engineer your work will include the solving of many bearing problems, but with a thorough knowledge of the design and application of Timken Bearings as part of your stock-in-trade you never need be at a loss for a satisfactory solution. Begin to acquire that knowledge *now*. Timken engineers will help you.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

Sand in Adolf's eye...

THIS man is a glass chemist. And the sand he's working with is going to get into Adolf Hitler's eyes and hurt.

Here's how. Glass, basically is made from sand. And glass in this war, in the skilled hands of American glass makers, is a potent weapon. It replaces metals on many jobs, metals needed for killing Huns and Japs.

In bombsights and fire control instruments glass helps to rain accurate death on the enemy. In heavy industries, such as the explosive industry, its characteristic resistance to corrosion speeds powder output. Glass in medical and laboratory fields puts us and our allies ahead in hospital treatment and in vital laboratory developments.

The U.S. is lucky in having a well established glass industry and not having to lean upon any part of the outside world for this essential material. Glass was ready for war, and was able to contribute to the speed records set by other industries such as gasoline and synthetic rubber.

It took a lot of research to make American glass the best in the world. At Corning way back in peacetime, more than 200 laboratory men were working steadily on new forms of glass and new uses for this amazing material. More than 25,000 formulae for glass were developed. Today around 250 different types of glass are in production under the "E" pennant at Corning's main plant.

There are glasses for example that withstand corrosive chemicals, that cannot be harmed by heat, that have high electrical insulating qualities, that are extremely resistant to mechanical breakage. And these are only a few of the reasons that engineers, too, consider glass the material with endless possibilities for the future. Corning Glass Works, Corning, New York.

CORNING
means
Research in Glass

KEEPING UP WITH

Electricity

1000 REVOLUTIONS PER SECOND! That's the speed of newest Westinghouse motor, producing a tool surface speed of 7,000 feet per minute. This 4 horsepower induction motor has a rotor only 2 inches long, diameter 1¾ inches. Westinghouse engineers are now developing a motor to go *twice as fast.*

B'R'R'R'R'R . . . A polar bear would be right at home at 20° below zero in the Westinghouse "igloo" at East Pittsburgh. This cold chamber is 1500 times as large as the average electric home refrigerator. Here, Westinghouse engineers test ice-coated circuit breakers and other electrical switching equipment, to guarantee operation under worst winter conditions.

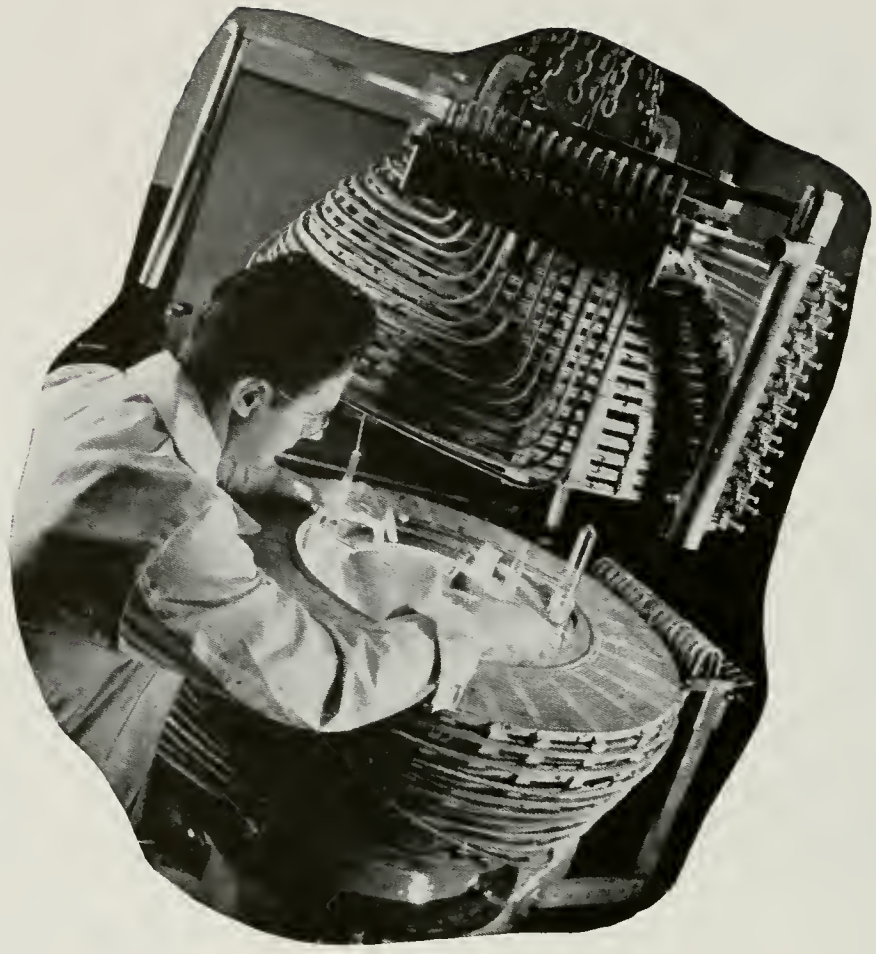
HIGH LIFE IS HARD on carbon generator brushes in high-flying bombers. They used to wear down to the pigtails in an hour or two, at 30,000 feet. Now Westinghouse engineers have developed a chemical treatment that keeps the brush face lubricated at substratosphere heights. Result: *fifty-fold* increase in brush life . . . enough for a dozen raids over Berlin.

EVER SEE A MILLIONTH of an inch? Probably you never will—but the Electrigage can *feel* as little as twelve millionths. Developed by Westinghouse and Sheffield Corporation, it can measure with a precision equal to finding an error of three-quarters of an inch in a mile. Infinitesimal movement of gauging stylus induces a tiny current, which is amplified 10,000 times.

AIR IS HEAVY STUFF when you start pushing it around at 400 miles an hour. That's why U. S. Army needed a 40,000 horsepower electric motor to create a man-made hurricane, for testing airplanes in Wright Field wind tunnel. It is the world's largest wound-rotor induction motor, designed and built by Westinghouse engineers.

. . .

The above items are condensed excerpts from articles in the WESTINGHOUSE ENGINEER, a bi-monthly engineering review. Regular subscription price—$2.00 a year. *Special price to students—50¢.*



Chemical analyses—*right now!*

Above is the laboratory model of the Westinghouse mass spectrometer, which sorts out dissimilar molecules according to their mass, and does it almost as fast as you can snap your fingers.

The mass spectrometer provides a new way to get the quick, accurate analyses that are needed to maintain precise process control. Take the synthetic rubber industry, for example. Formerly, five men took as long as three days to complete necessary chemical tests in the processing of artificial rubber—which meant that the results were often too late to be useful.

The new electronic "chemist," the Westinghouse mass spectrometer, now makes these tests in about 15 minutes.

For leadership in the electrical solution of industry's problems, look to Westinghouse. *Westinghouse Electric & Manufacturing Company, Pittsburgh 30, Pennsylvania.*

Tune in John Charles Thomas, NBC, Sundays, 2:30 p.m., E.W.T.

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Frontispiece . . .

GIANT SPARK GAP. By adjusting the space between these two spheres, Westinghouse engineers are able to regulate as many as 750,000 volts from a transformer before they are applied to a circuit breaker, under test at the East Pittsburgh works of the Westinghouse Electric and Manufacturing Co.

★

Cover . . .

Testing a reinforced concrete slab highway bridge under simulated truck loading in Talbot Lab. The strains in the reinforcing steel are being measured in order to check the mathematical analysis of this type of bridge.—*Cut Courtesy Westinghouse.*

ELECTRONIC HEATING

By EDWARD P. MURPHY, Cer. E. '44

Electrotheropeutics came into use in the late twenties. This method of producing artificial fevers or local high temperatures in humans by means of a high frequency current was the forerunner of dielectric heating. Induction heating made rapid strides in the thirties, but it wasn't until 1936 when the Thermex Engineering Corporation of Richmond, Virginia, undertook the evaporation of water from hogsheads of tobacco by using a very high frequency current that there was an industrial application of dielectric heating. This company was looking for a method of removing the moisture in undried tobacco without taking it from the hogsheads in which it had been packed. Their success led to the further development of diathermy, as it is also called. The next use which was found for diathermy in industry was the heat setting of glue and plastic bonded plywood. The Fairchild Company started using it for the plywood construction in airplanes.

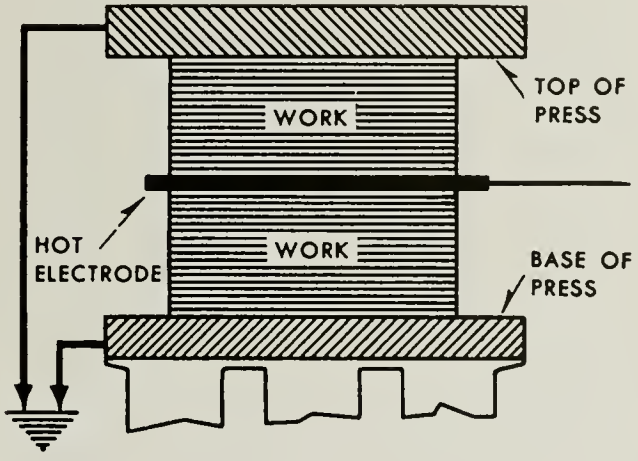


Fig. 1

Before going further into the uses of high frequency heating it might be well to consider what diathermy is. The heating unit acts as a large condenser, with the work to be heated located between the plates of the condenser and acting as a dielectric (See Figure 1). With ordinary industrial currents of 60 cycles the work, or material being heated, acts as a good dielectric. If the frequency is increased to from 15 to 20 million cycles, the effective dielectric resistance drops and permits enough current to flow through the dielectric to cause it to heat up. In a condenser the energy is stored in the dielectric. The current flowing through the dielectric aligns most of the molecules causing a molecular distortion. When the field collapses or is reversed, the molecules return to their normal position. When this reversal occurs many millions of times a second, the molecular movement is extremely rapid and causes the work to heat up. Considering the following formula:

$$W = E^2 \times 2\pi \times f. \times c. \times (p.f.)$$

the work in watts varies directly with the voltage squared, the frequency, the capacity, and the power factor. The power factor is constant for the material and the capacity is determined by the area and thickness of the work. This leaves us to adjust the heating done by varying the frequency or voltage. Notice that 10,000,000 cycles per second with 1000 volts will give the same amount of heat as 100,000 cycles sec. at 10,000 volts. The Gridler Corporation gave for a conversion factor 3,413 *BTU/Kw. hour*. This could be increased with larger machines and more efficient circuits.

The counterpart of dielectric heating is induction heating for metals or electrical conductors. The chief differences are in the frequencies and temperatures used. The dielectric method takes higher frequencies which range from 3 million to 20 million cycles per second with 3000 to 28,000 volts. The induction furnace uses frequencies of 600-12,000 or sometimes up to 500,000 cycles per second with 200-1000 volts. The lower frequencies are used for melting, and the higher for surface hardening. With the dielectric system the heat is held even throughout the work unless there is a path of a much smaller dielectric resistance, such as a wet glue line. In larger pieces where the thickness is a multiple of the wave length, standing waves often occur giving uneven heating. This tendency can be prevented by decreasing the frequency and increasing the voltage.

In induction furnaces the depth of heat penetration varies inversely with the square root of the frequency, and with magnetic metals the depth of heating is even less, depending on the permeability. Frequencies approaching those of dielectric furnaces are used for polishing tin plating, whereas for melting metals, frequencies as low as 60 cycles per second are used.

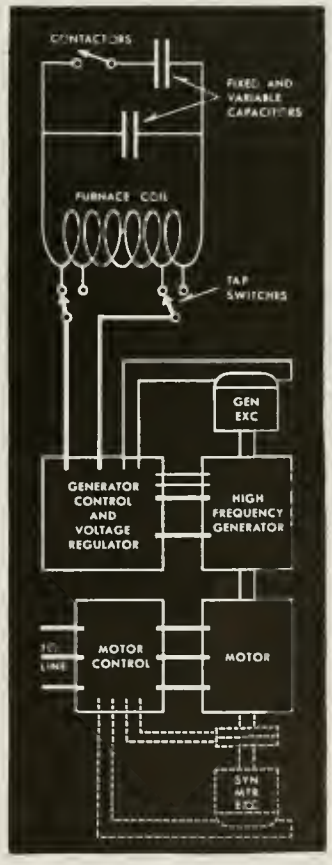


Fig. 2

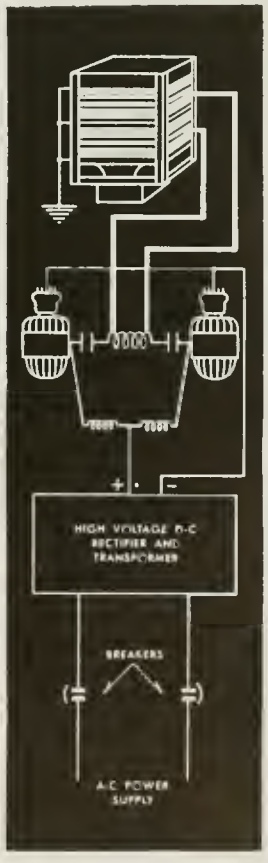


Fig. 3

In bonding plywood with a dielectric heater temperatures of 290° F. are seldom exceeded; 200-230° is the usual range. The induction furnaces can reach 3600° which is above the melting temperature of the graphite refractories commonly used.

(Continued on Page 15)

THE AIRCRAFT PROPELLER

By J. L. WILKINSON, Cer. E. '44

The propeller is the means by which an airplane is driven through the air. Often it is connected directly to the motor but sometimes it is necessary to employ reduction gearing in order that very high powered engines can be used. The propeller can usually be classed as either a constant pitch, an adjustable pitch, or a controllable pitch propeller.

The constant pitch propeller has been used successfully on all types of light, comparatively slow aircraft. It would have continued to serve had not high speed airplanes and supercharged engines become the order of the day. Only then was the inadequacy of such propellers and the need for a variable or controllable pitch propeller realized.

However, whether constant or variable pitch the principle is the same. It is primarily an air screw; it makes its way through the air in much the same fashion that a wood screw proceeds through a board or a bolt through a nut. While a wood screw has only one pitch the air screw has two pitches; the *geometrical pitch*, the theoretical distance a propeller would move forward through the air in one revolution, and the *effective pitch*, the actual forward distance which a propeller makes in one revolution. The difference between these two distances is called *slip*.

The propeller is actually a pair of rotating wings, that is, it has airfoil sections very similar to those used in wing design. The two "wings" are joined together at the base to form a hub which fits onto the engine crank shaft. The power of the engine is converted by the propeller into thrust horsepower when it moves the air backwards through it. This is in accordance with Newton's law: *for every action there is an equal and opposite reaction.* This useful forward reaction is termed *lift*. *Drag* is the resistance or torque which the engine must overcome. The most efficient propeller, obviously, would have the highest lift over drag ratio *(L/D)*. However, if such a propeller were rotated it would not be very efficient since the sections nearest the hub would be rotating very slowly compared to the tip elements. That is to say, at some point along the propeller the velocity and the pitch would be such that the greatest amount of lift would be obtained for the least amount of drag, but on either side of this elements the propeller sections would become increasingly inefficient. At the hub the pitch would be too small to create the same thrust as the most efficient element and at the tip the pitch would be too great. Therefore, the propeller blade is twisted so that it has a large blade angle and area at the hub and a small angle and area at the tip. In this manner every section on the propeller is made to exert the same thrust. We have now created a propeller that will operate efficiently at one certain rotational velocity of the propeller and one certain forward speed of the plane. If these conditions were to change the propeller would have to be redesigned.

In general the plane must operate under four different conditions which are: take-off, climb, cruising, and landing. Under each condition the forward speed and, consequently, the rotational velocity of the propeller is different. In take-off the propeller must create greater thrust than when cruising. To do so it must rotate faster in order to displace a greater quantity of air. A constant pitch propeller must be made to operate efficiently under one of these conditions (usually cruising) and the other three must be neglected. With a light, slow speed plane these conditions are not so different that when the propeller is constructed to work efficiently when cruising that it or the engine will suffer undue inefficiencies when taking off and climbing.

In order to secure the high speeds of modern aircraft a constant pitch propeller would have to be designed to have a high blade angle and rotational velocity when cruising. This design would be ineffective in taking off. In fact, the plane might not be able to take off at all without a very long run and then the climb would be sluggish. The only way in which the handicap could be overcome would be to increase the diameter of the propeller. This is undesirable, to say the least, for this would increase the drag, increase the tip speed, and make it necessary to increase the length of the landing gear. Hence, the need for a variable pitch propeller. With this type the blade angle could be turned down at take-off to enable the engine to turn up its rated r. p. m. When the plane attained level flight the engine would begin to race because of the decreased load on the propeller but by turning up the blade angle the engine would be held down to its r. p. m.

Another situation in which the controllable pitch propeller is a must is in the use of supercharged engines. Motors are designed to work under atmospheric pressures prevailing on the earth and so when a plane is flown at high altitudes it is necessary to compress the air for carburetion or suffer a loss in engine hp. This is called supercharging the engine. If a constant pitch propeller, designed to work in the lower atmosphere, were used in the thin air at higher altitudes it would revolve ineffectively causing the motor to race without doing any work. When using a controllable propeller it is only necessary to increase the pitch until it is handling a sufficient quantity of air to hold the engine down to rated r.p.m. Obviously, the speed of the airplane is increased and the efficiency of both the propeller and engine brought to maximum.

The first attempt at a variable pitch propeller was technically an adjustable pitch propeller. The propeller blades were fastened to the hub with ring clamps which could be loosened and the blades adjusted to a new angle by a mechanic. The adjustable type was but a little better than the contsant pitch propeller and both were rapidly displaced by the automatic or controllable propeller on high speed and heavy, powerful aircraft. Of course, the expense limits the use of automatic propellers to this class of aircraft and it will probably be a long time before the light plane owner will be able to enjoy the benefits mentioned.

The complete mechanization of the propeller is usually attained in one of three ways, any one of which is entirely satisfactory and used extensively on today's planes.

The first method utilizes the oil pressure of the engine lubrication system to force a change in the pitch of the propeller while in flight. A governor is geared directly to the engine so that it rotates with a velocity proportional to that of the engine. When the motor slows down the flyballs drop, opening a two-way valve, and the oil from the lubrication system is forced into the propeller by a booster pump to decrease the pitch. This is the condition which exists at take-off or when climbing. When the plane reaches level flight the engine picks up speed and the flyballs ride higher, opening the valve in the other direction. The oil drains from the hydraulic system with a resulting pitch increase.

Another system makes use of an electric motor which is controlled from the cockpit. A bevel gear, on the motor shaft, mates directly with gears on the ends of the propeller

(Continued on Page 15)

NAMES *in the* NEWS

By CHESTER D. MARQUIS, M.E. '45

LLOYD WALTON JONES

Lloyd comes from nearby Danville, and holds an average of 4.5 in Civil Engineering. He has been on honors day in his first three years and now has the University scholarship key. Membership in Phi Eta Sigma, freshman scholarship fraternity, came in his first year followed by Chi Epsilon, Civil Engineering honorary fraternity, and Sigma Tau, all-engineering honorary group.

As a member of the program committee for the campus branch of the American Society of Civil Engineers, Lloyd serves his fellow C.E.'s. At present he is working part time at the Talbot Laboratory on theoretical calculations for concrete slab tests.

LLOYD

In the last couple of years, Lloyd has been well occupied being a good C.E., but is still a sports fan and drags the clarinet out for a little music once in a while. He is postponing his former hobbies of stamp collecting and photography until after graduation when he has a little more leisure.

Lloyd plans to work in the aircraft industry, local board willing, for the duration, then try his hand at structural or highway work.

WILLIAM R. SCHMITZ

A chemical engineer from Percy, Illinois, he is in his last semester. Bill is president of the University of Illinois branch of the American Institute of Chemical Engineers. He is a familiar figure around the Wesley Foundation and in his first two years served on the Technograph staff, ironically enough, as editor of this column.

Bill is very much interested in athletics and although he has been rather well occupied otherwise he has managed to hold up his end as a fan and participant in baseball, basketball, and track. He enjoys playing the clarinet and treats himself to a few hot licks whenever he can find a little extra time.

A man who definitely knows how to squeeze the most out of his time, Bill holds a 4.68 university average, has been on all honors days since his arrival and has a University scholarship key. He is a member of seven (7) honorary fraternities (count 'em); Phi Eta Sigma, freshman scholarship; Tau Beta Pi, all-engineering honorary, of which he is master of initiation; Alpha Chi Sigma, professional chemistry; Phi Lambda Upsilon, chemistry; Omega Chi Epsilon, chemical engineering; Sigma Xi, research; and Pi Tau Pi Sigma, R. O. T. C. signal corps military honorary.

Speaking of this military angle, Bill held the top available basic-course R. O. T. C. rank of master sergeant for both semesters of his sophomore year, and was awarded the Scabbard and Blade citation for the outstanding sophomore in the signal corps that year.

Rather naturally, several choice offers for work in the chemical industry have been tendered to Bill, but he has held up any definite commitments until he has a better idea of what the near future holds in store for him, if you know what I mean.

As for the co-ed situation, Bill states that he is interested in several girls around the Campus and at home but, as yet, no one in particular.

When asked for a comment on the University, Bill stated that he believed that the courses stress too much theory and not enough practice. His idea, for after-the-war improvement of engineering education, is that the curriculum should embrace five years of work, alternating classroom theories with industrial practices. In this way a graduating engineer would really be a full fledged engineer capable of handling himself ably in competition with older and more experienced men.

BILL

I am afraid that this minute biography has sounded rather stilted and factual, but take it from me as one who knows Bill, he's really a swell fellow. His accomplishments are even more remarkable in light of the fact that he roomed with your humble columnist back in the old days.

(Continued on Page 17)

North of Green Street . . .

By H. W. NIEMAN, C. E. '46

Mechanical Engineers Hold Conference

The Central Illinois Section of the American Society of Mechanical Engineers held its Annual President's Night Dinner Meeting at the Jefferson Hotel in Peoria, on March 14. The three speakers of the evening were L. J. Fletcher, Director of Training, Caterpillar Tractor Company, who presented *Discussions of Post War Training Programs*; Mr. H. J. Neumeller, President of Illinois State Chamber of Commerce, spoke on *Industry and Its Post War Employment Problems*; and Mr. R. M. Gates, President of of the A. S. M. E., who presented *A. S. M. E. and Its Post War Problems.* All attending members were invited to air their own opinions on, and to discuss at large, the subject matter presented by the three gentlemen.

Members from the University of Illinois staff who attended the meeting were Professors Leutwiler, Mohn, Espy, Schroder, Trigger, Mr. Henry, Mr. Goglia, and Mr. Greffe.

* * *

A. I. E. E.

The student branch of the A. I. E. E. held a joint meeting with the Urbana section of the parent organization on March 20.

With many students graduating or leaving school to join the armed forces, the society's membership has dropped alarmingly. This is a matter of concern to the student body and the faculty members alike, and a call has been issued to all undergraduate E. E.'s to come to the aid of their departmental society. For information regarding membership, E. E. students should contact Mr. Roland Danner, phone 3280.

* * *

S. B. A. C. S.

At the last meeting of the S. B. A. C. S. the members were treated to a very interesting talk by Mr. C. E. Bails, President of the American Ceramic Society, and vice-president of the Ironton Fire Brick Company. In his speech, *A Quarter Century of Development in the Refractories Industry*, he discussed at length, in respect to method of manufacture and properties, each type of refractory that has appeared on the scene in recent decades. His lecture was well punctuated with amusing stories and anecdotes—the biggest whopper of which was one about a new super, super duty fire brick.

The annual A. C. S. conference will be held in Pittsburgh April 2-6. Several staff members are preparing papers which will be presented at that time. A number of the student body plan to attend and, ahem, we hope they have a swell time!!!

* * *

More About the Highway Conferenee

The Thirty-first Annual Conference on Highway Engineering was held February 16-18 under the direction of the Department of Civil Engineering, University of Illinois, with the cooperation of the Illinois Division of Highways and the Illinois Association of County Superintendents of Highways.

The conference got under way Wednesday morning February 16, with Professor W. C. Huntington presiding. After registration Dean M. L. Enger gave the opening address followed by two interesting talks given by Walter A. Rosenfield, Director, Illinois Department of Public Works and Buildings, and Wesley W. Polk, Chief Highway Engineer, Illinois Division of Highways.

The afternoon session was under the direction of Mr. C. L. Dees, Secretary-Treasurer of the Illinois Association of County Superintendents of Highways. Mr. R. H. Harrison, Assistant District Engineer, U. S. Public Roads Administration, spoke about the *Effect of Wartime Traffic on Our Highways.* Mr. G. Donald Kennedy of the Automotive Safety Foundation reported on the *Role of the Federal Government in Highway Development* and Professor J. J. Doland gave an interesting report on the University airport. Later in the afternoon the State Geological Survey, under the direction of Dr. George E. Ekblow, held open house for all the visitors. The object of the open house was to acquaint the men with the work of the Survey. Individual conferences were held later in the week for those who desired them. The day closed with a smoker at the Urbana-Lincoln where Mr. John C. Sauders of the Western Cartridge Company gave a short talk on *Small Arms, Military Guns, and Ammunition.*

The Thursday morning session began with Dean C. M. Thompson speaking on Post War Planning in Illinois followed by President A. C. Willard and Provost A. J. Harno reporting to the members the contributions of the University to the War effort. Later in the morning three timely films were shown.

During the afternoon the members heard talks on *Alaska and the Aleutians, The Relation of Adequate Highways to the Future Development of Air Transportation*, and *The Seabees in Action.*

The conference came to a close Friday morning with subjects pertaining to county highway programs. However, "The Last Word" was had by Professor C. C. Wiley when he presented a talk with that title.

* * *

A. S. M. E.

A recent election of officers by the A. S. M. E. found the following men taking office:

W. E. Stoud.....*President*
Dennis and Allen.....*Vice-presidents*
W. K. Banner.....*Treasurer*
C. R. Rankine.....*Assistant Treas.*
D. O. Wilson.....*Secretary*

The last meeting of the society was highlighted by a very interesting film on modern aircraft. It was stated that the next meeting would be held on March 22 and it was urged that all members attend.

* * *

A. S. C. E.

The annual election of officers was held at the last meeting of the student chapter of A. S. C. E. with the following results:

John Ascherman.....*President*
Harold Eckwoff.....*Vice-president*
James Wood.....*Secretary*
Bill Silckenna.....*Treasurer*

The new officers have a fine program planned for the coming semester with a meeting every three weeks. Professor Wilson spoke at the first one which was held March 23.

For the date, time, and place at which future meetings

(Continued on Page 17)

Tough problems in Engineering . . . licked in record time

New Radio—with 80 voices—revolutionized our tank warfare

IN 1940 the Signal Corps brought one of its toughest radio assignments to Bell Telephone Laboratories and Western Electric.

A rugged multi-frequency set was wanted for the armored forces. It must be, in effect, a radio switchboard to interconnect tanks, scout cars, command cars, artillery units, anti-tank vehicles.

The model was ready in one quarter of the time normally required to design and build such a complex set—an FM transmitter and receiver having 80 crystal controlled frequencies. Any 10 crystals could be quickly plugged in—and push buttons provided instant switching from one channel to another. The set was tested—accepted—ordered in quantity.

Meanwhile Western Electric engineers were tackling knotty production problems—tooling up of plant, training girls for the exacting work, procuring raw materials, setting up complex testing procedures.

Among the toughest problems were those of crystal manufacture. Millions of these tiny quartz wafers would be needed—each lapped to dimensions, silver plated in a vacuum, and mounted on wires so small that they must be soldered in place under a microscope. Amazing new machines and methods were devised—and the crystals came out on time.

Radio, electrical, mechanical and industrial engineers at Western Electric—Bell Laboratories men and Signal Corps men—all contributed invaluable aid. Early production goals were met—volume increased steadily.

Today huge numbers of units have been delivered. They are providing the instant communications that enable our armored forces to travel farther and faster and to hit harder!

Buy War Bonds regularly — all you can!

75TH ANNIVERSARY

Western Electric

IN PEACE, SOURCE OF SUPPLY FOR THE BELL SYSTEM
IN WAR ARSENAL OF COMMUNICATIONS EQUIPMENT

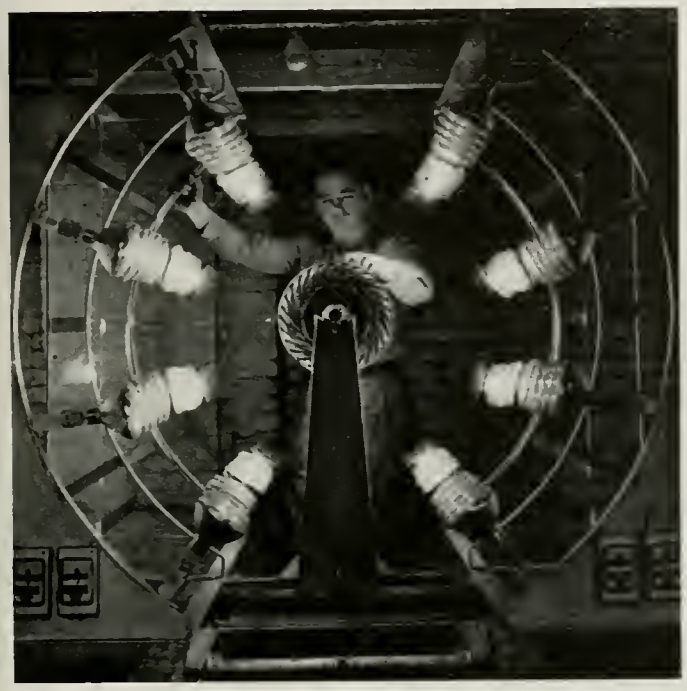
Tec

"RAY GUNS" FOR WAR RESEARCH. These electronic "ray guns" are 300,000 volt X-ray tubes which are to be used by the Army to make X-ray pictures of bullets as they crash through steel armor plate. Inside the tubes, a withering fire of tiny electrons produces a tremendous surge of X-radiation that will make a picture in a millionth of a second. The ultra high-speed X-ray machines, first developed in Westinghouse research laboratories, aid military ballistic experts to study the action of bullets in flight; in industry the machines make possible the study of rapidly moving machine parts. L. F. Ehrke, Westinghouse research engineer, is shown examining an unfinished tube.

☆ ☆ ☆

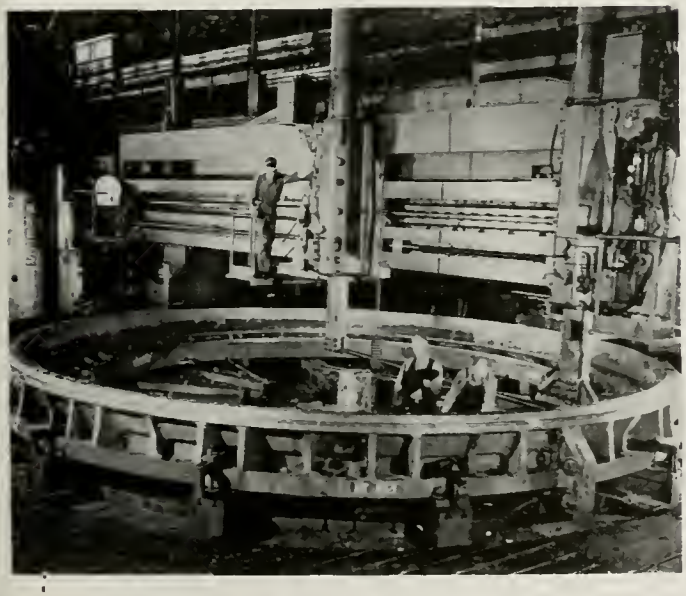
THE WORLD'S LARGEST DRAGLINE. This dragline digs 25 cubic yards at a time. Built by the Marion Steam Shovel Company, it has recently been placed in operation in a coal stripping property in North Illinois. The walking motion is controlled by the Rototrol, a Westinghouse development. This regulating generator minimizes stresses and shock on the entire machine.

ıno - Types



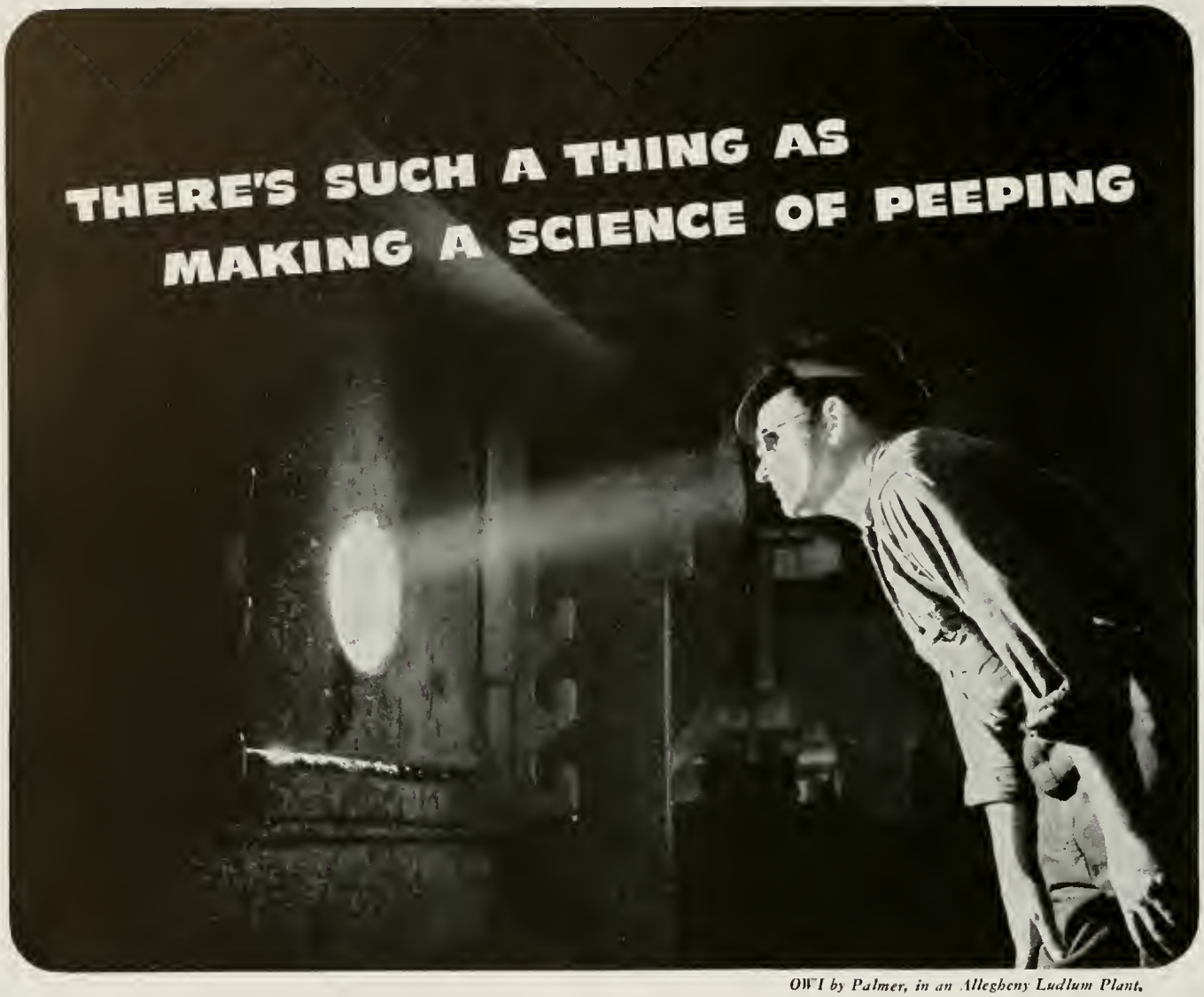
RADIANT HEAT SPEEDS ARMATURE REPAIRS. This oven with 120 250-watt Westinghouse reflector drying lamps is arranged in three sections with controls to permit the baking of one, two or three armatures at one time. Armatures are baked during the night, utilizing off-peak power by controlling the circuit with an automatic time clock.

LIGHTNING ARRESTER. With rated voltage of 226 kv, the arrester, one leg of which is shown here, carries the greatest capacity of any such structure yet built. The columns are built up from sections, and use of flexible joints imparts earthquake-proof resiliency to the rig. The hoop around the top is a grading ring to achieve uniform distribution of the electrostatic charges.



GUN MOUNT FOR UNCLE SAM. This big metal ring—the base for a large boring mill at the Westinghouse Electric and Manufacturing Company's East Pittsburgh works. Shipped in four sections, the ring weighs 92 tons. The Westinghouse boring mill is one of the few in the United States large enough to accurately machine this assembled ring. As the gun mount base ring slowly revolves, a forged steel cutting tool accurately machines a roller path surface.

Cuts courtesy of Westinghouse



OWI by Palmer, in an Allegheny Ludlum Plant.

WITH this melter, studying the action of some 35 tons of alloy steel in an Allegheny Ludlum electric furnace, peeping is resolved into a science.

His job is one of the earliest in a long series of operations which bring a melt of Allegheny Ludlum stainless, electrical or other alloy steel to its final form, rigidly true to specifications. His experience determines whether the molten mass within the furnace is progressing at the proper rate, and dictates any adjustments necessary to produce the quality of steel specified. His judgment is double checked, of course, by thousands of dollars worth of amazingly accurate testing equipment, built for analyzing with hairline precision.

For, in wartime especially, the properties of alloy steels must be maintained with the utmost consistency. Lives of men—even the outcome of battles depends upon this uniformity, because the place of alloy steels is always in the vital heart of a war mechanism.

Lives and battles depend upon other things in this war, too—matters that come home to every household. Buying bonds, conserving food, fuel, gasoline, rubber, waste fats and scrap metal—all these have to do with how soon the war will be won, and at what price. They are *everyone's* jobs. Have you done —are you doing—*all* you can?

AL
STEEL FOR THE NATION'S WELFARE

Allegheny Ludlum
STEEL CORPORATION
BRACKENRIDGE, PENNSYLVANIA

A-8841 . . . W & D

ELECTRONIC HEATING . . .

(Continued from Page 7)

For the circuit diagrams of the induction furnace and dielectric heating see Figure 2 and Figure 3. The induction furnace usually has a high frequency generator to supply the field because vacuum tube oscillators are inefficient much below 100,000 cycles per second. The capacitors in parallel with the furnace coil are usually automatic or hand adjusting to keep the power factor as near unity as feasible. The furnace can be regulated from a panel board or in heat treating or surface hardening the operation can be entirely automatic. The dielectric circuit (Figure 3) consists of a high voltage transformer and two vacuum tube rectifiers. The current is then fed to the oscillators and tank circuit. The tank circuit consists of an inductance coil and one or more condensers in parallel. In small jigs the electrodes are placed on either side of the work and put in a press. In larger machines with a stationary press one lead is grounded and the hot electrode is placed between two or more pieces of work; the grounded press serving as the other electrode. This last method is the safest for the operator. For variations in methods of setting work see Figs. 1 and 4.

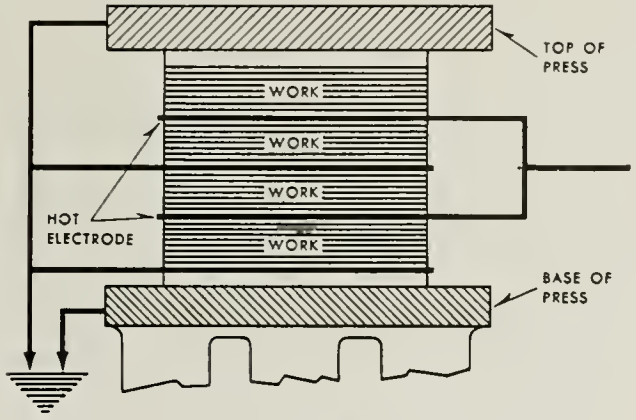


Fig. 4

The Fairchild Company, makers of airplane parts, have used dielectric heating for several years for forming spars and tanks out of plywood using a plastic bond. They were one of the few manufacturers who did not drop wood completely with the advent of stressed skin aluminum alloy airplanes. There are a number of glues and plastics that can be used for laminating plywood. Some of these are casein glue, urea formaldehyde, and phenol formaldehyde. The casein glue will set at room temperature in from six to eight hours, or faster if the temperatures are slightly elevated. The chief drawback is the short open assembly time, the time the glued wood can be left before it is set under pressure. Another difficulty is that this type of glue moulds when exposed to moisture.

The urea formaldehyde plastics are quick setting and moisture resistant. By heating to 200-230° F. with high frequency electric current the setting time can be reduced to 20 minutes. The chief cause for worry with this glue is that thick glue lines "craze" after a time, which weakens the bond considerably.

The phenol formaldehyde plastics are the best suited for the bond provided that they can be heated to 210-230° F. with dielectric heating. They have a long open assembly time, will not craze, have a high softening temperature, and can be successfully dried in 30 minutes at elevated temperatures.

The primary objection to the use of dielectric heating is its inefficiency. The ordinary type of electrical heating, resistance heating, is 100% efficient; fuel heating with coal or oil is 70-80% efficient; but dielectric heating is only 50% efficient. In spite of this handicap dielectric heating is often cheaper because there is no loss in conducting the heat to the material and because of the rapidity with which the work can be heated through the absence of a temperature differential.

The future holds numerous possibilities for dielectric heating such as drying intricate ceramic bodies, paper; in the manufacture of paper and cosmetics and in curing plastics and rubber.

Once a dielectric machine is properly installed the work can be done by an unskilled laborer with, perhaps, a technician for making adjustments when it is necessary to convert the machine to enable it to take care of other shapes.

THE AIRCRAFT PROPELLER . . .

(Continued from Page 8)

blade shanks and the pitch is changed by the pilot who has a pitch indicator located on his instrument panel. He reverses the direction of pitch change by reversing the fields of the motor with suitable switches.

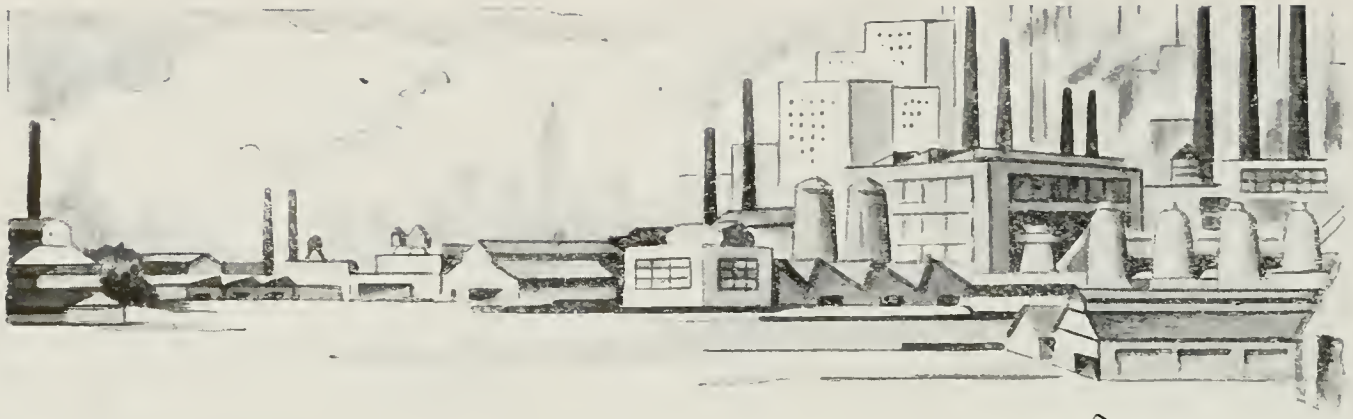
The last system operates on the electrical circuit of the plane. An electric motor is located in the hub of the propeller and is controlled by a governor that is geared to the engine. A planetary gear system makes the necessary reduction from the high velocity of the motor to the slow rotation of the gears which engage those on the ends of the propeller blades. It operates in much the same manner as the hydraulic system except, where in the first case the gears were activated by oil pressures and pistons, they are activated with an electric motor.

A feature which is often incorporated in the design of variable pitch propellers is one that enables the pilot to reduce the drag from the propeller blades on a dead engine. When a motor fails the blades present a large surface to the air causing drag. This drag tends to make the plane yaw in the direction of the dead motor. To decrease the drag the propeller is *feathered* or the pitch angle is increased to 90°. This is in effect a streamlining operation so that only the leading edge meets the air instead of the whole blade face. This feature also prevents the propeller from windmilling and causing further damage to the engine.

No matter what type of propeller is used, however, the rotational motion given to the slip stream causes the aeronautical engineer much trouble. By virtue of its rotation the slip stream impells on the rudder and fuselage surfaces and tends to make the plane yaw in a direction opposite that of the propeller rotation. On multi-motored planes this condition can be eliminated by installing motors which rotate in opposite directions on either side of the fuselage. There are several other factors which cause yaw and directional instability among which the most important is engine torque. To overcome the ill effects of these several items on single motored planes much work has been done by propeller designers and engineers on contra-rotating propellers. This is simply one propeller mounted immediately behind the first and rotating in the opposite direction. So far such installations have been used only experimentally for there are "bugs" which must be worked out.

'WALKIE-TALKIE GOES TO SEA'

Although developed to ride a soldier's back in steaming jungles, desert wastes, or arctic drifts, the "walkie-talkie" one-man radio station built by Westinghouse for the Army has now gone to sea. Its ten-mile range is short enough so that ships in convoy can transmit voice messages from vessel to vessel without using the "big" radio, which might give away ship location to enemy listeners.



BOILERS OF THE FUTURE

The pressure of war-time production has demanded of Babcock & Wilcox an ever-greater share of the responsibility for producing boilers for increased-capacity steam generating plants. A large number of Public Utilities, Industrial Power Plants and Ships have been equipped with B & W Boilers of modern design. These improved boilers will be available for FUTURE use in ALL industries. It would be well to familiarize yourself with B & W Boilers NOW.

BOOKLET

"The Design of Water-Tube Boiler Units" is a 14-page booklet that explains what type of boilers are used for various types of service. Copy FREE on request.

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HYDROGEN MAKES STEEL BRITTLE, G. E. METALLURGIST TELLS ENGINEERS

Tiny amounts of hydrogen in steel, even as small as one two-thousandth of a per cent by weight, can make steel brittle, and should be avoided in making metal for important war uses where toughness or ductility is essential. This is indicated by researches performed by Dr. Herbert H. Uhlig, metallurgist in the General Electric Research Laboratories, who reported on them at the meeting of the American Institute of Mining and Metallurgical Engineers.

While the effect of hydrogen is evident in ordinary steel, it is exaggerated in most steels containing manganese. Dr. Uhlig said. On the other hand, certain special manganese steels do not show it. This is attributed to a different arrangement of the molecules in the lattice that makes up the metal crystals. In general, where they have the arrangement known as "face centered," more hydrogen is dissolved than in the alternative "body centered" lattice.

In the body centered lattice, the atoms are arranged in cubes, one at each corner and one at the center. The center atom of each cube forms a corner of adjacent cubes, and so they interlock. The face centered arrangement, on the other hand, has an atom in the center of each face of the cube, and there is no interlocking.

GLYCERINE'S ROLE IN THE WAR

A recent release of the Office of War Information and the War Production Board, contains a most indicative report on glycerine and its importance and position in the war effort. This report makes it evident why glycerine is so vital and why civilian uses must necessarily be curtailed.

"Glycerin, simple component of hundreds of civilian products," says the release, "was drafted early in this war, not only for the explosive compound (nitroglycerine), but in many and varied military uses."

Among these uses is glycerine's place in medicinal preparations. In the Army, glycerine ranks second only to alcohol as a solvent in medicinal solutions, and glycerine is used in many types of surgical dressings. Aside from these uses, glycerine has many other indirect military reuqiremets. Thus the dull camouflage coatings on tanks and planes require large quantities of glycerine as do the special coatings used to protect sea-planes against the corrosive action of salt, water, wind and weather.

Cellophane made with glycerine is restricted to those military uses where durability is a main factor or as a packaging agent for food, where the toxic quality of glycerine substitutes prohibits their use. The most durable forms of cellophane go into capes for army personnel as a protection against possible mustard gas attack. Glycerine-containing glassine and greaseproof papers are restricted entirely to ordnance and food packaging. In the textile and leather fields, glycerine is a vital necessity to military dyes, as a leather softener, and as an adhesive in the manufacture of shoes.

"In the Navy," says the report, "the versatile nature of glycerin makes it irreplaceable in gun recoil mechanisms, in hydraulic control mechanisms and other equipment, in ship's steering gears and compasses, and again in the protective coatings for ships parts and guns."

Customer: "I want a man's comb."
Salesman: "Do you want a narrow man's comb?"
Customer: "No, I want a comb for stout men with rubber teeth."

NAMES IN THE NEWS . . .

(Continued from Page 9)

EVON CONSTANTINE GREANIAS, B.S.

Eve is a grad student in Engineering Physics and has been a research assistant in the University Physics department since his senior year. At present he is working full time with the department on a project of the National Defense Research Council.

This lad, who hails from the windy city, is the possessor of a respectable 4.5 in his course and is a member of Tau Beta Pi and Sigma Tau, all-engineering honoraries, and Pi Mu Epsilon, honorary mathematics fraternity. He is a holder of the University scholarship key and was graduated with honors.

On the other hand, Evon has a considerable interest in the world of sports. He was a member of the Illini track squad in his sophomore year and won his "I" in the junior year. Furthermore, he likes to swim, and is an ardent fan of a great many other sports.

As a further evidence of a rounded life, Evon served for three semesters on the Forum committee at the Y. M. C. A., was recently elected president of his house, Mull Manor, and has always tried to keep rather close track of the female element on the campus. As for the latter, it might be said that his interests are narrowing of late.

EVON

As to plans for the future, strange to say, this gentleman is rather uncertain, due, in great measure, to his possession of a 1-A classification. At present he is working on a commission in the Navy. Despite these difficulties he has hopes of doing graduate work in the field of electronics at an eastern university.

Eve lists good music, art, logic, math and physics along with sports as his hobbies.

RALPH LLOYD PORTER

Another Chicago product, Ralph is this semester president of the Illinois Alpha chapter of Pi Tau Sigma, national honorary fraternity in Mechanical Engineering. His all-university scholastic average figures out to around 4.4, and it is rumored that he received the mythical five-point in M.E. last semester.

Ralph is a very active member and past president of the Chi Psi fraternity. He now holds the office of vice-president in that organization.

At present, this gentleman is the proud holder of a 2-A occupational deferment until the middle of April, at which time he goes back to the uncertainty cycle of the contemporary engineering student's life.

Ralph is known in unofficial circles as the best-dressed engineer on the campus (excluding the faculty, of course) and, I am told, is quite an operator with the women. He

RALPH

is one of the best liked Mechanical Engineers around and is one of these rare people who has learned to plan his work in such a way as to prevent the growth of grey hair and hold down the consumption of midnight oil.

NORTH OF GREEN STREET . . .

(Continued from Page 10)

will be held servicemen and freshmen C. E.'s need only to watch The Daily Illini.

* * *

Illinois University Graduate at Westinghouse

S. M. Shatausky of Chicago, Ill., a recent graduate of the University of Illinois, has joined the Westinghouse Electric & Manufacturing Company as a member of the Company's graduate student course.

One of more than 250 young men selected from colleges and universities throughout the country, Mr. Shatausky is receiving engineering and classroom instruction designed to fit him for active participation in the Company's war production program and for future leadership in the electrical industry.

The course was originated by Westinghouse over 50 years ago to help college graduates bridge the gap between academic preparation and actual production work.

Born in New York City, Mr. Shatausky was graduated from the University of Illinois with a Bachelor of Science degree in electrical engineering.

The Department of Engineering granted leaves of absence to three staff members during December. From the E.E. department W. E. Miller and Professor H. J. Reich have left and the M.E. department will lose Sam Sachs.

Mr. Miller received a commission as ensign in the Navy and left for duty about December 1.

Prof. Reich left the campus January 1 to join the staff of the Radio Laboratories at Harvard University where he will occupy the position of an expert in electronics research.

Mr. Sachs will also leave, about the middle of January, for war service.

"Sacrificial Corrosion"

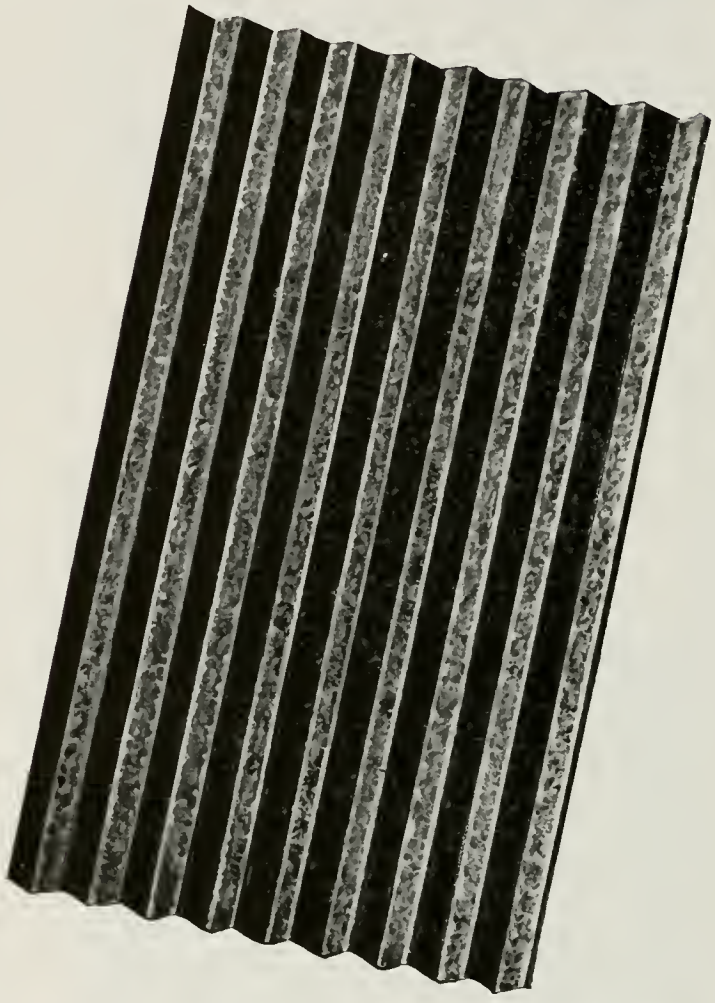
. . . . do you know what it means?

The zinc coating on galvanized sheets or other products protects the iron or steel underneath in two ways: 1, by simple coverage, with a sheath of rust-resistant metal; 2, by electrochemical action or "sacrificial corrosion". The first is clearly understandable, but the second is more complex.

When two metals are put into an acid solution or electrolyte, each will tend to oxidize and to cause an electric current to flow toward the other. The metal more chemically active will oxidize more rapidly and produce the stronger current, and will keep the other metal from oxidizing. This is known as "sacrificial corrosion".

Remember the old "door-bell battery", with the zinc and copper elements? How the zinc gradually oxidized, or corroded away, while the copper was practically unaffected? Here the zinc saved the copper by sacrificial corrosion.

Through an electrochemical action similar to this the zinc on galvanized sheets gives the second kind of protection to the iron or steel base metal: the moisture in the air acts as the electrolyte in microscopic electric cells formed by the zinc and any exposed base metal, and then by "sacrificial corrosion" the zinc keeps the iron or steel from rusting.



ZINC is "by far the Best" Protective Metallic Coating for the Rust-Proofing of Iron and Steel

KEEP YOUR WAR EQUIPMENT FIT AND FIGHTING — FOOD FIGHTS for freedom

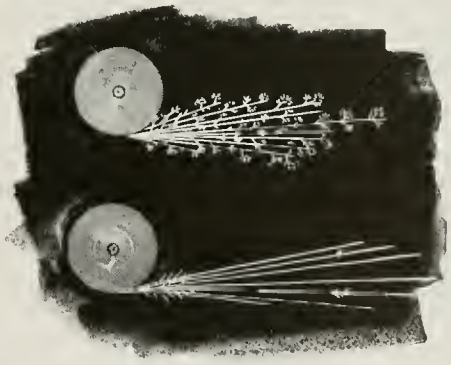
All sorts of buildings for the storage and processing of food are covered, roof and sides, with galvanized sheets. Certain steps can be taken which will make this material render better service and last almost indefinitely. These are described in the booklet "How to Make Galvanized Roofing Last Longer", which the Zinc Institute has prepared as part of its contribution to the "Food Fights for Freedom" campaign. It is a booklet worth having. Write for it—it's free.

American Zinc Institute
INCORPORATED
60 East 42nd Street, New York 17, N.Y.

"Can you tie this one, Mr. Sherlock Holmes?"

1 It's a cinch if Sherlock Holmes were around today he'd probably know that the quick way to tell one type of steel from another is by a simple spark test. If a piece of steel stock has lost its identification it must be submitted to a time-consuming chemical analysis unless there is some quick means of telling just what it is. In war plants this spark test has saved tons of alloys and thousands of man hours so essential to the war effort.

2 When you touch the end of a piece of steel with a grinding wheel it gives off characteristic sparks and colors which tell its approximate composition. This dramatic method of conserving strategic materials is another rather interesting and unusual use of grinding wheels such as made by Carborundum.



3 Whether it's spark testing metals, tool sharpening, production grinding or any other operation where you use grinding wheels, when you get out in the field remember that there is a Carborundum Engineer ready to help solve your problems. The Carborundum Company, Niagara Falls, N. Y.

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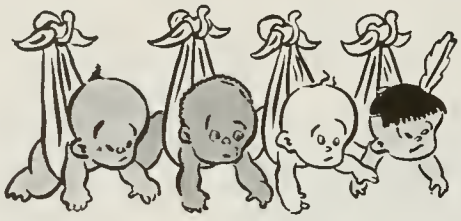

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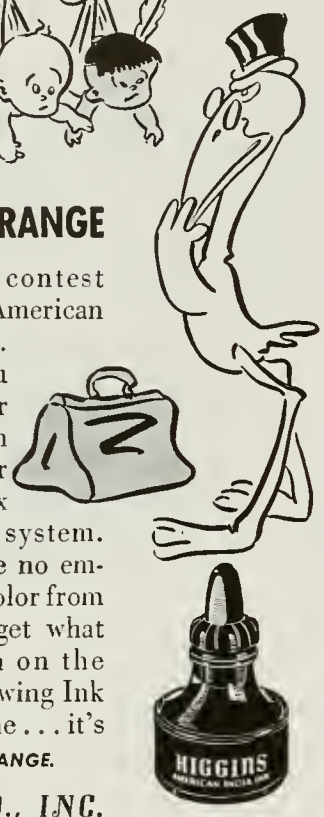

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TECHNOCRACKED

"I see you dated an A. S. T. P. student."
"No, I tore my dress on a nail."

* * *

Jonesi: "How about a kiss, baby?"
Steve: "Not on an empty stomach."
Jonesi: "Of course not—on the mouth."

* * *

Campus belle (jokingly): "May I chew your gum?"
Chet: "Sure; which one, upper or lower?"

* * *

Warden: "Prisoner, you have one hour of grace."
Prisoner: "Okay, bring her in."

* * *

A young newlywed was sobbing because her husband was out shooting craps and she didn't know how to cook them.

* * *

Voice from passing car: "Engine trouble?"
Voice from parked car: "Nope."
Voice from passing car: "Tire down?"
Voice from parked car: "Didn't have to."

* * *

"Where is that chicken I ordered an hour ago?"
"It'll be along soon, sir. The cook hasn't killed it yet, but he is getting in some nasty blows."

* * *

We wonder why the iceman smiles so
When his gaze happens to meet
The sign: "Please drive slow;
The child in the street
May be yours, you know."

* * *

Nightwatchman (in any European town): Eight o'clock and all's hell.

* * *

And then there's the one about the rookie engineer who thought a neckerchief was the head of a sorority house.

* * *

"So you've been to college, eh?"
"Yeah."
"How high can you count?"
"One, two, three, four, five, six, seven, eight, nine, ten, jack, queen, king, ace."

* * *

The boat was sinking, and the skipper rushed up to a bunch of frightened passengers.
"Who among you can pray?" he asked.
"I can," replied a minister.
"Then you start praying, mister," ordered the skipper, "and the rest of you put on life preservers. We're one short."

* * *

"Your girl is spoiled, isn't she?"
"No, it's just the perfume she's wearing."

* * *

Owner: "How did you come to puncture this tire?"
Son: "Ran over a milk bottle."
Owner: "Didn't you see it in time?"
Son: "No, the kid had it under his coat."

* * *

Preacher's daughter: "Good morning, God."
Co-ed: "Good God. MORNING!"

* * *

Doctor: "What you need is a little sun."
Co-ed: "Oh, Doctor!"

Hands that Command the Nation

THE TECHNICAL KNOWLEDGE, the ingenuity and the resources of America are at the disposal of our skilled medical officers on the fighting fronts of the world. They command every aid the nation can supply. That is one reason why a wounded man's chances of survival are greater today than they have been in any other war.

Among the materials that are helping medical men in their fight to save lives are the *stainless steels*. Used in operating tables, surgical instruments and in other medical equipment, stainless steels are serving in hospitals in this country and overseas.

Frequent sterilization with high temperature steam or strong disinfectants will not injure stainless steels. Their smooth, hard surface is easily kept free from germs that can cause fatal infection. Even in the damp tropics, stainless steels do not rust. Tough and durable, free from the possibility of chipping, stainless steels can withstand the rigors of wartime use.

On the home front, too, stainless steels are making their contribution to the health of the nation. Because they are easier to clean and keep clean than other metals, they are widely used in equipment necessary to the processing, preparing and serving of foods. They keep their bright finish, impart no flavor to food, and resist food chemicals. They will be used increasingly in restaurants, in the home, and in many industries where their unique properties are so desirable.

Stainless steels are "stainless" because they contain more than 12 per cent chromium. Low-carbon ferrochromium, a research development of ELECTRO METALLURGICAL COMPANY, a Unit of UCC, is the essential ingredient in the large-scale production of stainless steel. Units of UCC do not make steel of any kind. They do make available to steelmakers many alloys which, like ferrochromium, improve the quality of steel. The basic research of these Units means useful new metallurgical information—and better metals to supply the needs and improve the welfare of mankind.

▼

Members of the medical profession, architects and designers are invited to send for booklet P-3. "THE USE OF STAINLESS STEELS IN HOSPITALS." *There is no obligation.*

CARBON FOR HEALTH. Research by a UCC Unit has resulted in different forms of carbon used in milk irradiators, "sun" lamps, gas masks—and in air conditioning installations.

GASES FOR HEALTH. LINDE oxygen U.S.P. made by a Unit of UCC is used by the sick in hospitals and at home and it contributes to the safety of our high flying aviators.

CHEMICALS FOR HEALTH. Synthetic organic chemicals, developed by a Unit of UCC, mean better anesthetics, more plentiful sulfa drugs, vitamins and other pharmaceuticals.

PLASTICS FOR HEALTH. BAKELITE and VINYLITE plastics, produced by UCC Units, mean sanitary paints, floor coverings, sheeting, "burn sleeves" and other essentials.

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PLASTICS
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Johnny, Get Your Gun!

Before John Murdock convinced skeptical Londoners of 1815 that his new discovery, coal gas, was a fuel and not a conjurer's trick, he had to find pipe that would convey the gas safely. Pipe of available materials such as lead, wood and clay either leaked, broke or fouled chemically. Finally, John tried a gun barrel. It worked! If one gun barrel was good, a mile of them would be perfect! So reasoned Murdock, as he spliced and, by heat and hammer, welded all the gun barrels he could buy, borrow or beg, into the world's first steel pipeline. Those gun barrels were the beginning of the present network of little and big inch steel pipelines and safety cylinders and carriers which transport liquid and gas fuel everywhere.

For nearly a century, The Harrisburg Steel Corporation has been known among oil and gas industries for seamless steel products which must meet exacting demands with excellent service and perfect safety. Some of these oil and gas products are seamless steel pipe couplings, pump liners, hollow and drop forgings and pipe flanges. Harrisburg also manufactures seamless steel high pressure cylinders, and liquefiers, alloy and carbon steel, coils and bends. Every "Harrisburg" product conforms with the highest standards in test and inspection.

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War Invention May Provide Floating Rides for Trains and Autos

Servo-mechanism principles that enable American tanks to fire on the run with such devastating effect quite possibly will provide "floating" rides in high-speed trains and other vehicles, according to Westinghouse engineers. Actual development work on these applications has been started. Calculations show that the power required to stabilize the vertical movement of a railroad coach is only about three horsepower. The mechanism necessary to accomplish this is small enough to fit into an over-night bag.

Curiously enough, the servo-mechanism to stabilize a railroad car will require about the same power and be about the same size as that required for an automobile. Here is the explanation: the equipment required depends on the weight of the object multiplied by the square of the up and down movement of the road. The automobile is much lighter, but the vertical movement is several times that of a railroad car.

Imagine the newsboy's embarrassment when he opened the wrong door in the depot waiting room and yelled, "Extra Paper!"

* * *

A young lady taking a vocational course in the operation of a factory machine defined a bolt and nut as follows: "A bolt is a thing like a stick of hard metal, such as iron, with a square lump at one end and a lot of scratching wound around the other end. A nut is similar to a bolt, but just the opposite, being a hole in a little chunk of iron, sawed off short, with wrinkles around the inside of the hole."

* * *

A man was fumbling at his keyhole in the small hours of the morning. A policeman saw his difficulty and came to the rescue.

"Can I help you find the keyhole, sir?" he asked.

"Thash all right, old man," said the other, cheerfully, "you just hold the house still and I can manage."

* * *

Senior Chem: "Give me some of that prepared minoaceticacidester of salicylic acid."

Druggist: "Do you mean aspirin?"

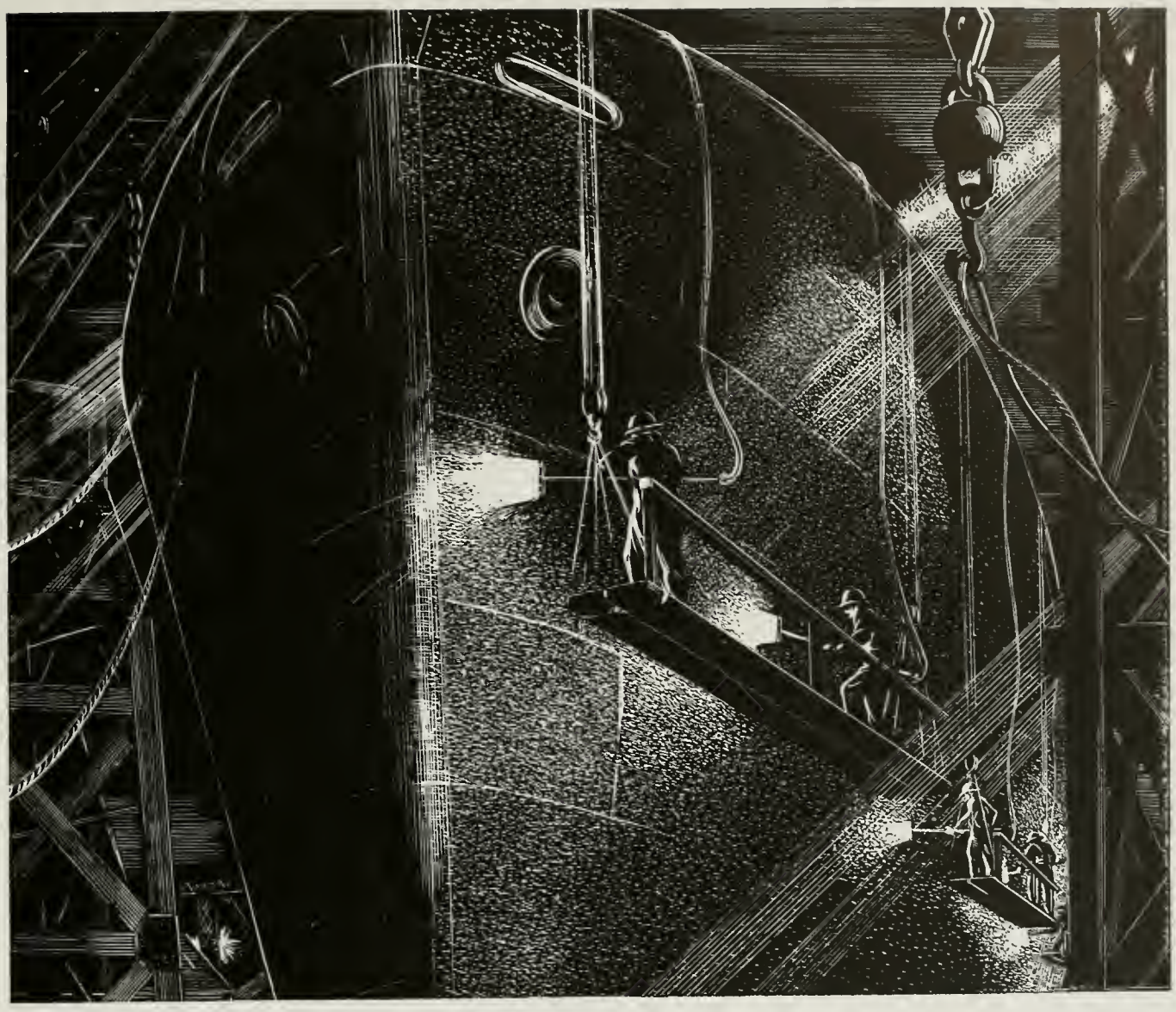
Chem: "Yeah! I never can remember the name of that stuff."

* * *

Pat: "Father, can I ask ye a question?"

Priest: "Sure, Pat."

Pat: "Well, Father, I know all about Shrove Tuesday, Ash Wednesday, an' Good Friday, but what the divil, an' whin is Nut Sundae?"



Scrubbing Steel Ships with Brushes of Flame

Painting a big modern cargo or troop ship is an expensive and important finishing operation. To assure the longest possible paint life, many large ships are first thoroughly cleaned with "brushes" of oxyacetylene flame — a steel-conditioning treatment that produces a clean, smooth surface unblemished by rust or scale.

Moreover, this modern steel-cleansing method drives occluded moisture from the steel, thus making it more receptive to paint and making paint jobs last longer. As a result, repainting becomes a much less frequent necessity...maintenance costs are considerably reduced.

In addition to cleaning steel, the oxyacetylene flame has many other uses. It cuts metals into any shape quickly...surface hardens them at points of wear... welds them into strong parts. With the electric arc, it constitutes a remarkably fast, versatile metal-fabricating team.

If you would like to receive our informative publication "Airco in the News," we shall be glad to send a free copy. Write to Mr. G. Van Alstyne, Dept. C. P., Air Reduction, 60 East 42nd Street, New York 17, N. Y.

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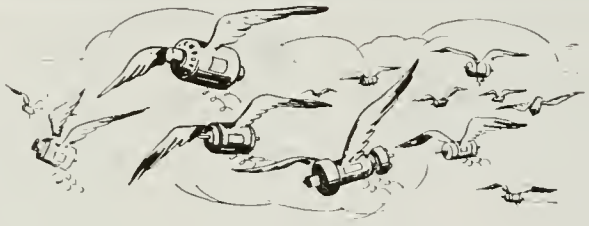
Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

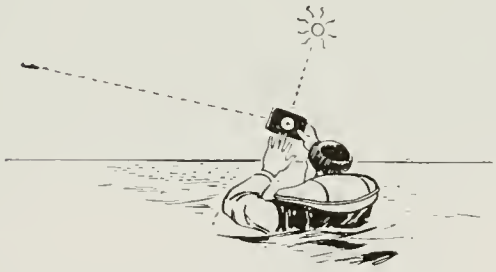


FLYING FAMILY

WHEN a big bomber or a punchy fighter thunders off the field to keep a date high over an enemy target several hundred miles away, many electric motors go along with it—but not just for the ride.

From the time the starting motors turn over the cold engines till, back over the home field, a combat-weary man presses a button and the retractable landing gear lowers from the plane's belly, electric motors are doing hard, exacting work.

These motors, seemingly delivering power out of proportion to their lightness, have taken over most of the tiring muscular jobs . . . like lifting and lowering the flaps against tremendous and varying wind pressures . . . like swinging around the gun turrets at the gunner's slightest signal. And thousands of these are G-E motors, being supplied in ever-increasing numbers for armament operation and for the actuating parts of planes.



SOLAR SEARCHLIGHT

WHEN a dazzling point of light gleams on the broad seascape, and when suddenly that point becomes a blinding glare that persists in following your plane, chances are a man is adrift at sea and needs your help.

He is using one of the new emergency signaling mirrors, designed by General Electric in co-operation with the Coast Guard, the Bureau of Standards, and the National Inventors' Council.

These mirrors are already aboard hundreds of lifeboats and rafts. The shipwrecked sailor follows three simple steps, printed in large letters on the back of the mirror, to shoot a beam of sun-glare at a target—and that target may be a plane or ship up to ten miles away.

UPSTART

MAYBE you've wondered how the big Fortresses and Liberator bombers of our Air Forces operating from the cold Aleutians, Newfoundland, and Iceland—can be started in such cold climates without a moment's loss of time.

One of the reasons is a small General Electric device—the starting vibrator for aircraft engines—one of the three hundred and more G-E developments for our fighting planes. This starting vibrator provides a very hot spark which helps aircraft engines to start instantly, regardless of weather conditions.

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

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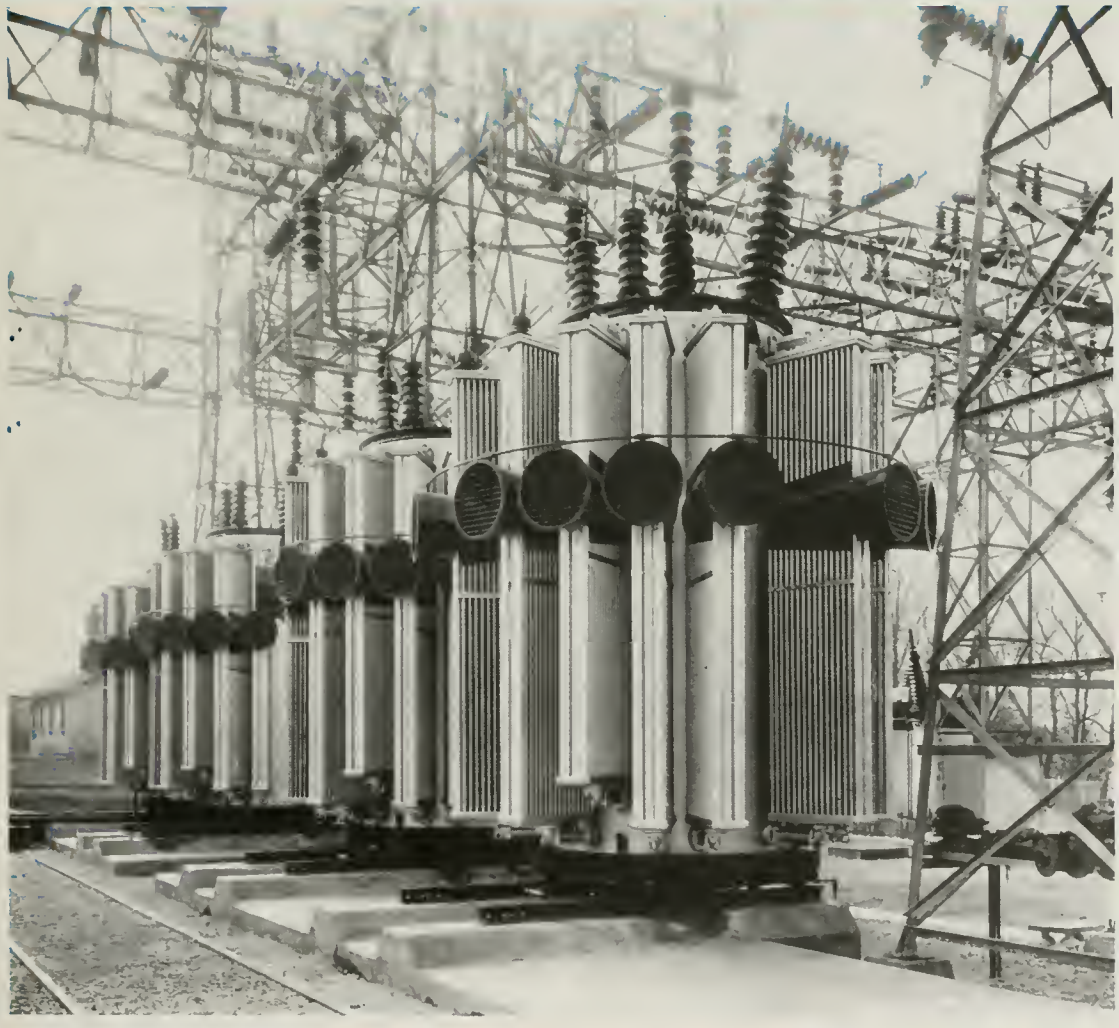
ILLINOIS TECHNOGRAPH



APRIL
1944

★

ELECTRO-RELAYS

DON'T OVERLOOK MINING

COMPREG

NAMES IN THE NEWS

TECHNO-TYPES

ELECTRONICS

TECHNOCRACKED

Established 1885 Member E.C.M.A.

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A Valuable Post-War Asset for Every Student Engineer . . .

Until Victory has been won, all the Timken Tapered Roller Bearings we can make will continue to go into war equipment of all kinds and into the many different types of machines that help to make them.

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Learn to know your bearings now; this knowledge will pay dividends after Victory, no matter what kind of mechanical equipment you may be designing. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

The promise of plastics, in the after-war years, holds so much for manufacturers and consumers alike that perhaps we should learn a little more about the nature of these new materials.

Of prime significance, chemically made plastics are unlike any structural material we have had to work with in the past.

Plastics are the product of chemistry. They are one of the outstanding examples of the chemist's ability to produce—out of coal, petroleum, air, salt, and other basic elements —totally new substances.

Important to an understanding of plastics is that they differ widely in their property characteristics.

For example, some plastics are extremely tough and withstand rough usage. This is true of Ethocel—one of the Dow plastics. Other types are pliable. Some have almost optical qualities in their clarity. Others possess excellent electrical insulating value. Some withstand heat and others extreme cold.

Among Dow plastics possessing some of these properties to a high degree is Styron—a plastic especially valuable as an electrical insulator and having many other uses where lustrous beauty or resistance to acids and alkalis are factors of importance. Saran, on the other hand, is notable for its tensile strength and flexibility, which make it widely used for such products as tubing, woven fabrics and rope. Ethocel, in a special formula, is especially strong and tough at extremely low temperatures.

JUST WHAT ARE "PLASTICS"?

The important point to remember is that the science of plastics is progressing rapidly. Already there exist many specialized plastics for specific applications. As our knowledge of both plastic compositions and the techniques for handling them increases, these new materials will undoubtedly become even more widely used than is now planned.

Dow Plastics include
Styron, Saran, Saran Film, Ethocel and Ethocel Sheeting

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DOW
CHEMICALS PLASTICS MAGNESIUM
INDISPENSABLE TO INDUSTRY AND VICTORY

KEEPING UP WITH

Electricity

LANDING ON A DOT is commonplace for our warplane pilots today, thanks to new blind-flying instruments made by Westinghouse. There are two pointers in the instrument — one to give pilot his *direction* — the other, his proper *gliding angle*. By manipulating flying controls to keep both pointers crossed over a dot on the dial, pilot can locate field and land blind in fog or darkness.

ALL THE KING'S HORSES — 990,000 of them—would be needed to equal the power generated by six giant Westinghouse water-wheel generators at Grand Coulee Dam—largest of their kind ever built.

ZIP . . . A certain type of gyro flywheel must snap up to full speed (12,000 rpm) *in just 1/5th of a second*. Westinghouse engineers devised a 10½ pound midget 22 horsepower electric motor to do the job. Secret of fast starting lies in special brushes that carry 600 amperes to the armature—at a density of *1600 amperes per square inch of brush area.*

YO! HO! A 50-foot mast performing sea service many miles from salt water, rolls more wildly than any crow's nest in a storm. The mast top travels 30 miles an hour, in swinging back and forth through a 90° arc every six seconds. Westinghouse developed this land-going mast to test sensitive shipboard electronic devices under conditions more severe than they will face at sea.

SAVED—800 MAN-HOURS PER SHIP. By changing the design of Victory ship gear cases, Westinghouse engineers saved 1/5 of a mile of arc welding (about 800 man-hours) on each case. Bending some of the thick steel plates, to make right angles (formerly welded), made possible this important saving in production time.

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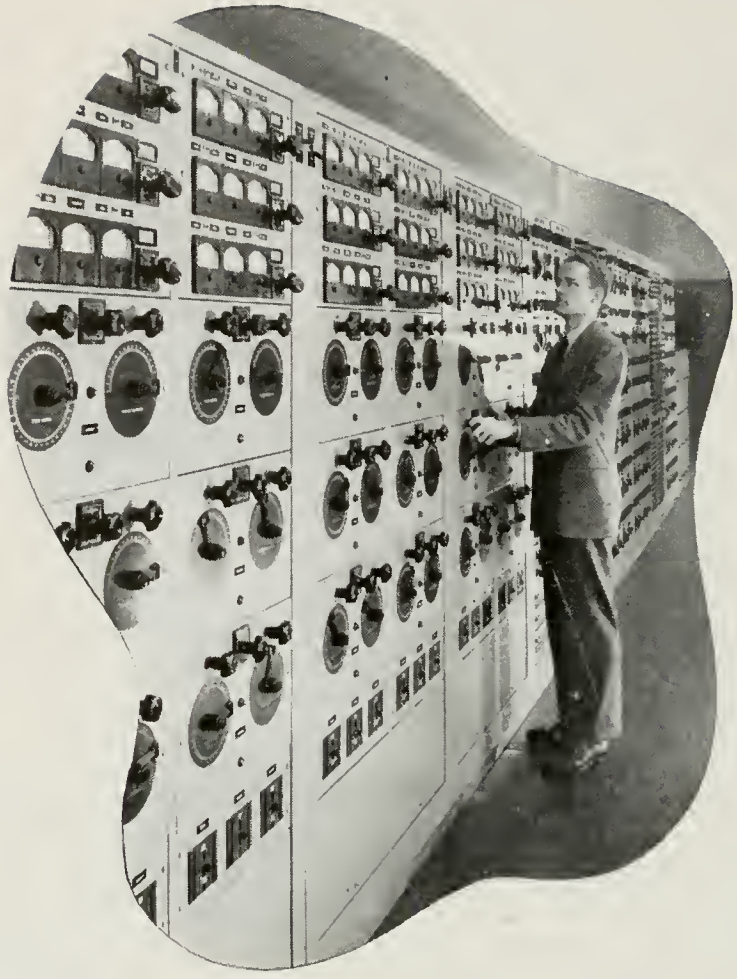
The above items are condensed excerpts from articles in the WESTINGHOUSE ENGINEER, a bi-monthly engineering review. Regular subscription price—$2.00 a year. *Special price to students—50¢.*



Getting the right answers—*fast!*

Pictured above is a remarkable "electrical brain" that enables an engineer to solve—*in a single hour*—intricate calculations that would take him more than 100 hours by mathematics. And other calculations, impossible to compute by *any* other method, are easily solved.

It's the new Westinghouse Network Calculator. The first model was developed in 1929 by Westinghouse engineers to help them analyze the electrical characteristics of a huge power system—by creating a *synthetic replica* of the system to laboratory scale.

Now, even before a new electrical system is built, the calculator can reproduce in miniature the electrical characteristics of the proposed system—and can quickly calculate the changes in equipment needed for best results.

Today, this new and improved Westinghouse Network Calculator is available at our East Pittsburgh Works for making studies of public utility and industrial power systems. Another Westinghouse service to industry — giving the right electrical answers — fast. *Westinghouse Electric & Manufacturing Company, Pittsburgh 30, Pennsylvania.*

WESTINGHOUSE PRESENTS John Charles Thomas, Sunday, 2:30 p.m., E.W.T., NBC. "Top of the Evening," Monday, Wednesday, Friday, 10:15 p.m., E.W.T., Blue Network.

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APRIL ★ 1944

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THE TECHNOGRAPH

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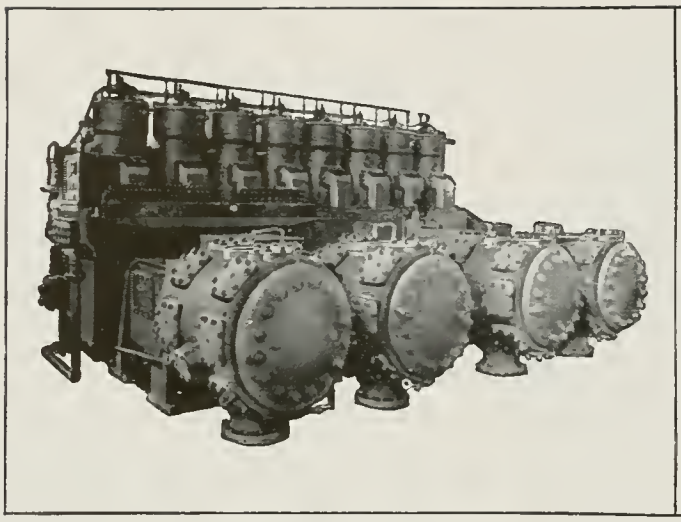
Cover . . .

13,000-volt power from the generator is stepped up five, ten, or more times by these immense, oil filled step-up transformers. *Cut Courtesy Westinghouse.*

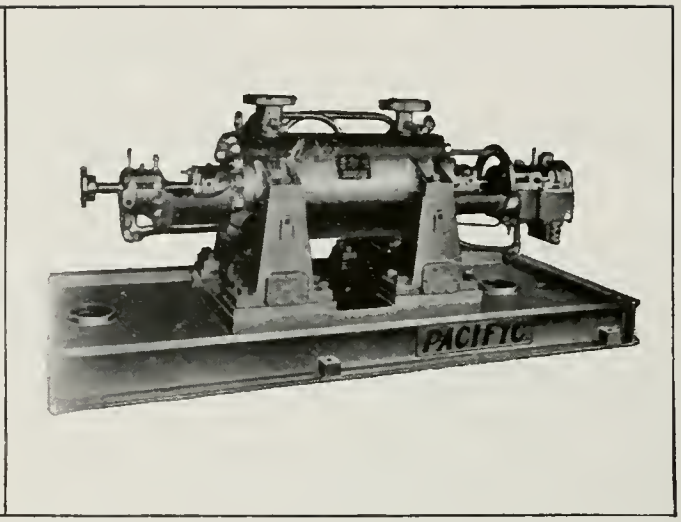
★

Frontispiece . . .

The craftsman works at close quarters in a Westinghouse plant as he nears completion of the wound stator of a 3,750-kilowatt turbine generator built to give a U. S. Naval Air Station its own source of power. *Cut Courtesy Westinghouse.*



CLARK 8 Cyl. 800 B. H. P.
GAS ENGINE DRIVEN COMPRESSOR



Pacific Type ITB—Hot Oil, Multi-Stage Horizontal, Forged Steel Shell, Double-Case, High Pressure Centrifugal Pump.

Achievements in the Field

Half of Clark Bros. 64-year history has been largely devoted to developing and perfecting the "2 Cycle" Engine. Clark engineers, with far-sighted vision, recognized "2 Cycle" as the ultimate engine as long ago as 1910. Years of successful experiment and research produced the modern Clark "2 Cycle."

No greater tribute could be paid Clark for the hard pioneering years, than the wide acceptance Clark "2 Cycle" enjoys today, not only throughout the Petroleum Industry, but in many of the world's largest war industries such as Synthetic Rubber, Synthetic Ammonia and Toluene plants.

Illustrated above is the Clark 8 cylinder—800 B. H. P.—"2 Cycle" Gas Engine Driven Compressor. Because of its notable records in outstanding Recycling and Pressure Maintenance plant, petroleum engineers consider it "standard equipment."

Twenty years ago Pacific Engineers, in a modest little pump shop, startled the world with a radically new oil pumping technique. In those days oil pumps were costly and unreliable. They either ground themselves to uselessness in a few months or corrosion did the trick.

So these alert Pacific engineers took the micrometer, new alloys, finest of materials and developed new engineering methods. They created a group of precision pumps that defied all oil field and refinery pumping conditions—pumps of efficiency and economy with a life measured in years instead of months.

Today—in a large modern plant—Pacific still maintains its leadership with a complete line of centrifugal, turbine and plunger types of precision pumps for water well, oil well, refinery, pipeline, process, boiler feed and hot oil operations, as well as large emulsion pumps for synthetic rubber plants.

CLARK BROS. CO., INC.
Olean, N. Y.

PACIFIC PUMPWORKS
5715 Bickett St., Huntington Pk., Cal.

"Two of the Dresser Industries"

UNION CARBIDE REPORTS

first full-year's production of

BUTADIENE

for the Government's Synthetic Rubber Program

(INSTITUTE, W. VA. PLANT)

Night view of the immense butadiene plant at Institute, W. Va.

A LITTLE OVER A YEAR AGO* the first tank car of butadiene was shipped from the Government's large integrated rubber project at Institute, W. Va. This historic shipment came from the immense butadiene plant which was designed and built by CARBIDE AND CARBON CHEMICALS CORPORATION for the Government's Defense Plant Corporation—and is being operated by this Unit of UCC. for the Rubber Reserve Company.

FIRST YEAR'S PRODUCTION OVER THE RATED CAPACITY— that is the record of this huge 80,000-ton-per-year plant during its first twelve months! This has been accomplished in spite of the many inherent problems that had to be solved in starting a wholly new project of this magnitude.

Over 8/10 of a short ton of butadiene is required to make about one long ton of Buna S type synthetic rubber. Butadiene from this plant during the past year has provided more than 90,000 long tons of synthetic rubber for the Nation's requirements, both military and essential civilian. The delivery of this all-important ingredient also has made possible early production of synthetic rubber under the Government's program.

*The first tank carload of butadiene from Institute was shipped on February 18, 1943 — less than one month after Unit No. 1 of the four large butadiene-producing units had started operating. Subsequently, Unit No. 2 started producing in March, Unit No. 3 in April, and Unit No. 4 on May 25, 1943.

NOW HUGE BUTADIENE PRODUCER—although originally designed to produce 80,000 tons annual capacity, the Institute plant is now delivering butadiene at a rate of more than 100,000 tons per year. An identical plant using Carbide's process was put into operation by the Koppers United Company in September, 1943, at Kobuta, near Pittsburgh, Pa.

OVER 75% OF THE TOTAL PRODUCTION OF BUTADIENE for the Government's synthetic rubber program in 1943 came from the alcohol process developed by CARBIDE AND CARBON CHEMICALS CORPORATION.

In addition to the plant at Institute, Carbide made available plans for the large plant at Kobuta, which was built and is being operated for the Government by Koppers United Company.

CARBIDE AND CARBON CHEMICALS CORPORATION also has designed and built for the Defense Plant Corporation, and is operating for the Rubber Reserve Company, another large butadiene plant at Louisville, Ky.

▼

Business men, technicians, teachers, and others are invited to send for the book P-4 "Butadiene and Styrene for Buna S Synthetic Rubber from Grain Alcohol," which explains what these plants do, and what their place is in the Government's rubber program.

BUY WAR BONDS AND STAMPS

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PLASTICS
Bakelite Corporation
Plastics Division of Carbide and Carbon Chemicals Corporation

The material herein has been reviewed and passed by the Office of Rubber Director, the Rubber Reserve Company, the Defense Plant Corporation, and the War Department.

the Electro-Magnetic Relay

By CURTIS DONNEL, E.E. '46

In histories of inventions of telegraphy much stress was placed upon the invention of the telegraphic relay. To Joseph Henry and to Morse it seemed a complete apparatus for the indefinite transmission of telegraphy over land. Years later, however, a more complete relay had to be constructed that would respond to the current generated by the varying resistances of the carbon transmitter. This relay was termed the telephone relay. To visualize the problem that science was faced with, some observers thought that about one per cent of the telephone current was transformed into sound waves; the remaining ninety-nine per cent being dissipated as heat. The idea of the use of induction on a neighboring circuit at several points was adopted, and from that time on, the use and developments of the relay have increased tremendously.

Today the relay is more important than ever before. It is serving tirelessly and relentlessly for multi-speed operations of all kinds all over the world.

Webster's Collegiate Dictionary gives the definition of the relay as "An electromagnetic device operated by a variation in conditions of an electric circuit, and which, when so operated, operates in turn, other devices, as a switch, in the same or a different circuit."

The relay, as it is commonly thought of, consists of a coil of a number of turns of wire, and an armature of some ferromagnetic material. The coil is energized by a very small current, which in turn causes the armature to move in a desired direction with a force proportional to the current times the number of coil turns, or ampere-turns. In doing so, the armature is capable of exerting a mechanical force on an external switch. For example, take the relay manufactured by C. P. Clare & Co. as shown in *fig. 1*. The

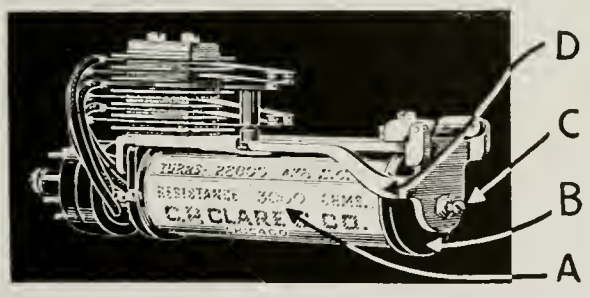

Fig. 1

coil (A) is energized by a small current, thereby causing the armature (B) to move toward the coil. The armature is fastened to the top of the relay by means of a brass bearing. The residual screw (C) extends beyond the armature on the coil face side, and determines the length of the air-gap when the armature is in its operating position. The armature arm (D) moves upward against the armature springs. The armature springs in turn move upward; the lowest spring being moved by the armature arm, and each succeeding spring being moved by the bakelite bushings that are riveted to the under side of the spring.

The "ears," or the part of the spring where the terminal connections are made, are staggered in order to increase the distance between successive springs, thereby decreasing the possibility of a short-circuit. The relays are subjected to a 1000 volt A.C. break-down test before leaving the factory. A breakdown test is a test to check the insulation for breakdown characteristics greater than would be encountered in actual service. The check for open winding is made by applying a current to the relay and checking it for operation.

The armature springs, as well as the other springs used in the spring assembly, are made of cold-rolled nickel-silver stock. Nickel-silver is used for the springs because it gives a high conductivity as well as being able to retain the tension necessary for this type of relay.

An iron core is placed inside the coil of the relay to concentrate the flux produced by the coil, and consequently the ampere-turns, or force needed to move the armature, is less than it would be if no core were used. If a relay is to operate on direct current an ordinary iron core is used, but if the relay is to operate on alternating current, a laminated iron core must be used so that the eddy current loss is reduced to a minimum. This is especially true if high frequency current is used, because the loss would be much greater than at ordinary frequency. In the latter case the loss would be proportional to the frequency.

One of the governing factors in the design of a relay is the heat that is developed in the coil. The heat in watts is equal to the product of the current in amperes squared times the resistance in ohms. I^2R=power lost in watts. The maximum temperature that is developed is dependent upon the type and size of conductor, and also the type of wire insulation. These temperatures may vary from 200 to 300 degrees F.

The heat dissipating area of the coil depends upon the number of turns that are wound on the core, or the depth of the winding on the core. As the number of turns are increased, the outside area, or the dissipating area, is increased.

The heat that is developed may be as high as four watts per square inch; however, it is recommended that one watt per square inch be considered maximum for a relay that is covered, and one and one-half watts per square inch for silk insulated wire.

The contacts are attached to the springs by various means; the most common of which is spot-welding. With spot-welding a good contact is assured, because the entire base of the contact is fused to the spring. C. P. Clare & Co. spot-weld tiny hemispherical shaped contacts near the ends of the springs. The type of contact that is used depends upon the continuity of operation, contact pressure, and the current that is to be carried by the spring. The springs of the relay are part of the external circuit, and open or close the external circuit by the movement of the armature. The normal contact pressure is 35 grams; this pressure being selected to furnish the force necessary to remove the film and tarnish caused by atmospheric conditions. This pressure is also necessary to hold the contacts together in the event there is a slight jarring of the relay during operation.

If relays are to be used where the vibration is excessive, such as in aircraft or ships at sea, the contact pressure may be as high as 70 grams. In this case, the mechanical strength of the contact has to be considered. Platinum-Irridium contacts are generally considered the best for this use; however, tungsten contacts are sometimes used.

Westinghouse research engineers have found that if relay contacts are made hollow and partially filled with a metallic powder, the poor connections are eliminated by the bouncing and chattering in electrical relays.

The design of alternating current relays is slightly different than the design of direct current relays. 'Chattering" in alternating current relays is caused by the current alter-

(Continued on Page 20)

DON'T OVERLOOK MINING

By MARION B. WALLS, Min. E. '44½

From the depths of antiquity there comes the story of the farmer who, when asked how the potatoes turned out, replied, "They didn't turn out—the boys had to dig 'em out." While this article does not deal with either farmers or potatoes there is a modern-day counterpart of this condition. The present problem is the unavailability of technical men for the mining industry. They don't "turn out." In fact, in both Ill. and Pa. the industry is now providing scholarships in an effort to produce their own men.

It is odd that this condition should exist when one considers that with the exception of the agriculturists, mining is the oldest occupation. Even today these same two are still the basic producers of the world's goods. This point seems to have been overlooked, and it is paradoxical that although these are the only true producers and all other industries are built on the use of their products, mining should have been so side-tracked in the modern educational scheme. And it is even more strange when one remembers that although governments recognize the great importance of mining the people as a whole should forget it. The basis of most wars is economics and this economics is tied up with natural resources, chiefly minerals, because they are vital, and yet, because mining is so common it is forgotten. It is a common trait of the human race to overlook the commonplace.

Because the author is more familiar with coal mining this phase of the problem will be discussed, but the metallic mines have essentially the same problems in obtaining technicians. Perhaps part of the fault lies in the mines and mining people themselves. With the powerful advancements made by the electrical engineers, the present strides forward by the metallurgists, and the more romantic connotation associated with the title of civil engineer, mining engineering has been eclipsed. During the past decade or so many of the largest schools have dropped their mining curriculum entirely, and in most of the other schools it has dropped in importance. The result has been that when the operators of the mines needed technical men they have been forced to hire other engineers and then convert them to mining engineers.

This would seem to indicate that prospects in mining engineering are dismal, or else more people would be enrolled in studying it; and yet this is another of the many paradoxes connected with mining which make it so interesting. Why is the reverse true? Simply because it has been neglected so long there is now a scarcity at the very time when there is the greatest need.

This need is very evident in coal mining as this branch of mining is destined to resume its former position of importance in the affairs of the world and, in fact, to even surpass its greatest glory if given wise guidance. If this guidance develops, and far-sighted coal men are starting the nucleus now, then there will be great opportunities for skilled engineers in the not too distant future.

A look at the past history and background of coal mining should be introduced at this point in order to make more clear the present problems. Like other industries, when the machine age developed, the mining industry turned to machinery to increase production. That they did a thorough job cannot be denied. One mine in the author's experience at one time had over twelve hundred employees, but since becoming completely mechanized it turns out the same amount of coal with only one-half that number of men. This same condition is reflected throughout the coal fields. For instance, last year with only four hundred thousand men, a loss of near sixty thousand to the armed forces, the bituminous coal mining industry established a new record of 589,000,000 tons of coal produced, this despite the incorrectly publicized "strikes". Illinois is one of the most mechanized and figures of it will show how machinery has increased efficiency. In 1923 it took 93,681 men at over 300 mines to produce 61,406,093 tons, whereas for a comparable production of 61,124,628 tons in 1942 it took only 30,022 men working at only 141 mines. In 1942, 86.8% of the coal mined underground in Illinois was mechanically loaded.

Of course, this increase was due to the impetus of war, but during normal times the average production is about 385,000,000 tons. But here is where the hitch is: to produce this coal most of the mines only average between three and four days of work each week and most of the days of operation are concentrated in the winter months. The seasonal work has caused unstability and is detrimental to both the worker and the operator. The worker has no definite income upon which he can rely in making plans, and it is almost needless to say that the operators do not like this unstable condition. When money is invested in equipment and the equipment lies idle for long periods there is loss of returns. When overhead mounts, profit declines, and no one gains. And beyond the fact that there is this loss of potential production, there is also the effect of sporadic use of the equipment. Mechanics recognize that in many ways machinery resembles humans. In order to keep themselves in good condition athletes exercise every day. They know that they cannot do all their conditioning in one day as it might be too strenuous and they might pass their physical limit, and even if they could, and then tried to take all their rest at one time they would soon become soft and out of condition again. The comparable sameness holds true for machinery. Machinery cannot be run for long periods of time without pauses, and conversely, neither can it lay idle for long periods without deteriorating effects. All this means money out of the pocket with nothing to show for it, and as mines are run by economics this is a serious problem.

Therefore, stability is the prime requisite. Production and efficiency have had the greatest attention in the past, and have been worked out so well that they have far surpassed the demand. Now the question is, how can we gain this stability? Logically, the answer is to increase the demand, but this brings up the further question of how to go about it.

This is where the opportunities for young mining technicians begin. And on this point the picture is not as clouded as would seem suggested, but in reality it is very bright. This is almost a virgin field of endeavor as only the groundwork has been set up.

While the coal producers were concentrating on increasing production the oil industry was quick to enter the heating fuel business, and it is admitted that at the present time they are a major competitor with their cleaner and more compact heating units. But many prominent geologists are pessimistic concerning oil reserves. The United States produces 70 per cent of the world's supply of oil at the present

(Continued on Page 24)

Compreg . . .

By CHRIST D. KACALIEFF
Research Assistaut, T.A.M.

Given an impetus which only a war can give, the plastics industry has forged ahead with an ingenuity unparalled in many industries. One of the recent major developments in plastics and wood which is receiving much attention is a new product known to the trade as "compreg, "high density plywood," or "resin-densified wood." It represents a unique combination of wood veneers and plastic resins which lends unusual physical properties to the product.

Compreg is made by impregnating or soaking wood veneers with a plastic resin, drying the coated sheets, and then placing piles of the treated veneers between the heated platens of a hydraulic press. Press temperatures range from 260° F to 360° F, pressures between 900 and 3,000 pounds per square inch, and press or curing time (time required for the setting of the plastic resin) between 20 to 200 minutes. Press time varies with the thickness of the product while the bonding pressures are determined by the desired density of the final product.

Various types of plastic resins or glues have been used in the manufacture of compreg, the particular type of resin depending in some measure on the applications of the material. However, the general purpose phenolic resins which are thermosetting (inability to change shape by heating after initial fabrication) are being used more extensively than the thermoplastic resins (ability to change form when subjected to heat). A resin particularly suited for impregnation is a resin at substantially the phenol-alcohol stage of condensation applied in an aqueous solu-

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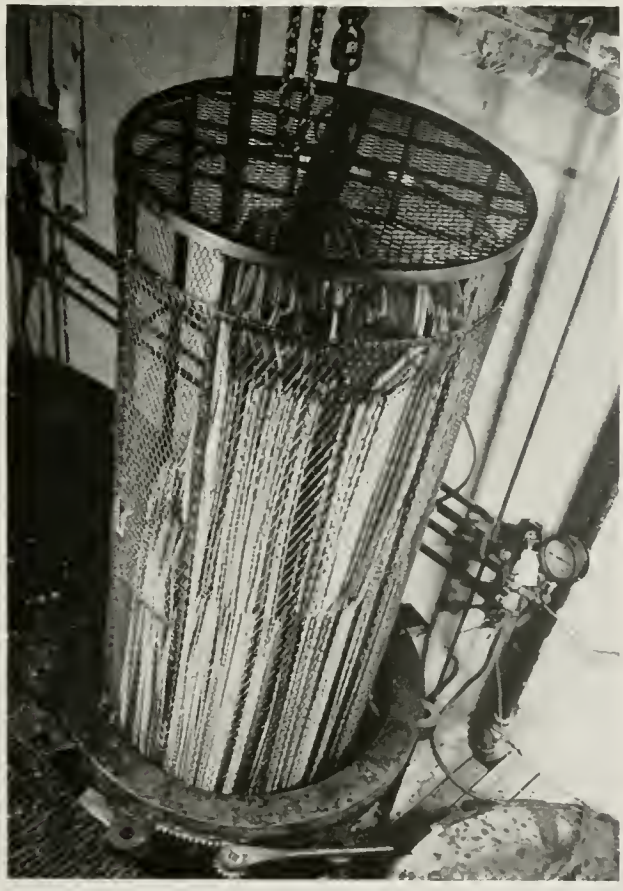


First step in manufacture of compreg is to stack veneers on a rack. Rack is then lowered into a tank for impregnating with phenol varnish where vacuum is maintained first, followed by pressure.

Machined propeller made from compreg.

NAMES *in the* NEWS

By CHESTER D. MARQUIS, M.E. '45

ROLAND VICTOR DANNER

Rollie, a Chicago product, has the distinction of composing one-third of this semester's graduating class in the department of Electrical Engineering. Furthermore, he is president of the campus branch of the American Institute of Electrical Engineers for this year.

Rating about a 3.5 average in a plenty tough course, Rollie is holding up his end of the scholastic situation and is quite active in his fraternity, Phi Kappa. He guided that organization as president last semester, and has been representative to the Interfraternity Council for the past two years.

As a great fan of amateur radio work, Rollie was a most interested member of Syn-Ton, amateur radio fraternity when it was active on the campus. As a matter of fact, Rollie had his own amateur radio station in Chicago in the pre-war days. If you can recall that far into the past, you may recognize his slogan: "This is W9BYG, the Rainbow Station." Blue, yellow and green, get it? Very tricky, Rollie. In other days when time was a little less precious, gas-model building also contributed to the leisure occupation of this gentleman.

Roland spent his first year at Northwestern University, before seeing the light. (Apologies, where due). He comments that he has a regular lady friend these days who lives a little west of Chambana town.

ROLLIE

For a comment, Rollie states that he thinks it is up to the individual to learn on his own initiative the knack of getting around in the campus picture, and still keep up the grades. He believes further that such courses as Logic and Psychology are excellent for Engineers and that more encouragement should be given them.

JOHN CALVIN ASCHERMAN

In this day of alphabetical designation Johny C. should be known as a B.M.O.C., and very big on the engineering campus. He is a senior Civil Engineer with roughly a 4.35 average, and is serving his fellows as president of the American Society of Civil Engineers and Chi Epsilon, C.E. honorary. As though holding the two most important jobs in the C.E. school weren't enough, John is prexy this year of his fraternity, the Triangle house.

JOHNNY

As for studying, suffice it to say that J. C. made honors day his first three years, possesses a U. of I. Scholarship Key, and is a pledge to Sigma Tau, engineering honor fraternity.

John hails from Lovington over by Decatur, and very reliable sources have it that he is engaged to a very lovely girl from that fair city.

He has as hobbies photography, gas-model airplane construction, and possesses a very fine stamp collection, although he admits all have suffered temporarily to some extent in these busy days. He played solo cornet in the high school band for five years, but had to give that up for now.

John's father gave him an airplane for his graduation from high school, which, no doubt, accounts for his present interest in structural steel work, particularly as applied to aeronautical construction. He has a great many solo hours and regrets that he had to quit flying and sell his plane because of war-time restrictions.

At present Johny is helping to run impact tests on reinforced concrete beams at the Talbot Laboratory, and in the future would like to design airplane structures for the National Advisory Committee on Aeronautics.

He says, "I have wanted to be an engineer for as long as I can remember. Engineering is a fascinating field and is tops with me. I've never regretted my step of getting in!"

RICHARD LOUIS CONKLIN

Dick is definitely a candidate for an "Interesting Illini Engineers" gallery. He is a senior in Engineering Physics and is one of a great many fine people on the campus from Rockford.

Along the executive line, Dick is president of Sigma Tau, honorary in engineering, one of the four present officer-members of Tau Beta Pi, all-engineering scholastic

fraternity, and is vice president and corresponding secretary of the Triangle house. For the past two years he has been chairman of Publicity and Editor of the official organ, "The Mac" at McKinley Presbyterian foundation.

The fact that Dick has plenty of ability and grey matter is further evidenced by his being on honors day for three years, earning a University Scholarship Key and being a member of Pi Mu Epsilon, mathematics honorary, and Phi Eta Sigma, freshman men's scholastic honorary. He worked on the Illio staff and the Illini Union music committee in his first year here. He served as first and master sergeant, respectively in his last two semesters in Basic R.O.T.C. and was awarded the American Legion Medal as best sophomore in the Signal Corps that year.

Writing, stamp collection, ship model construction and music are among Dick's hobbies. He says he is interested in the women on the campus in a general way only, at least for the present.

Dick is of the opinion that the engineering course is inclined to be too narrow and should include more "cultural courses." He likes Engineering Physics very much indeed and he is particularly fond of Light and Optics and Electricity. He says that there is too much arguing about the best branch of engineering. He says that each is necessary and has its place in the cooperative picture of life today. In closing, Dick mused that he would like to see the world's operation transferred from the politicians to the engineers. "They might do a much better job."

DICK

WILLIAM HARRISON SEVERNS

As senior manager of the Star Course concert series for this year, Bill has made a definite place for himself in campus life, and contributed greatly to the entertainment and culture of a great many Illini.

Bill says that he hasn't figured his average lately, but that it stands at "something over 4.1" He is treasurer of the student branch of the American Institute of Chemical Engineers and a member of Alpha Chi Sigma, honor-social chemistry fraternity.

In his first year Bill was a member of the First Regimental Band and served on the staff of The Daily Illini his first two years.

Although he has not had time to participate much in athletics, Bill is quite a sport fan. He likes also to listen to good music when he hasn't too much Chemistry to do.

As for the women, we quote, "I'm playing the field just now."

Bill has a 2A deferment until August (Who am I kidding?) and has been working on applied commercial and analytical chemical testing for the Chemistry department.

By the way, Bill is an Urbana boy. His father is Prof. W. H. Severns of the department of Mechanical Engineering.

BILL

Asked for criticisms of his school, his curriculum, and his fellow engineers, Bill responded, "I like everything just fine the way it is."

That's what we like to see, a satisfied customer.

COMPREG . . .

(Continued from Page 11)

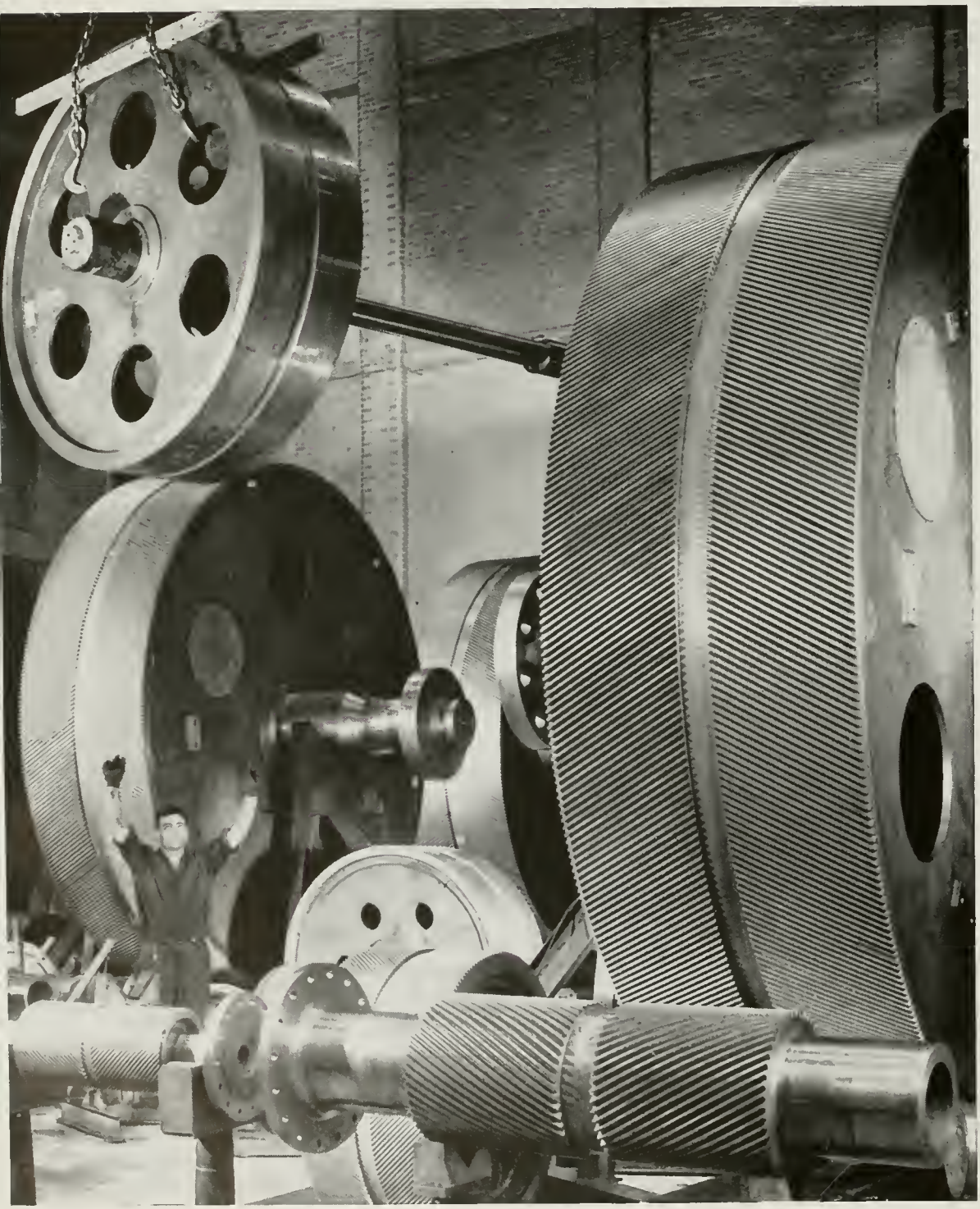
tion. The small and highly polar resin molecules penetrate into the cell walls and are thought to combine at least loosely with the cellulose of the wood resulting in a dimensionally more stable, although more brittle, material.

Checking impregnated dried wood for size, direction of grain, and weight of assembly prior to pressing.

The effects of resin on wood are many. Resin (1) tends to plasticize and soften the wood so it can be compressed to high densities. Most attention at present is being given to a product whose specific gravity is 1.4 which is close

(Continued on Page 26)

TECHNO -TYPES

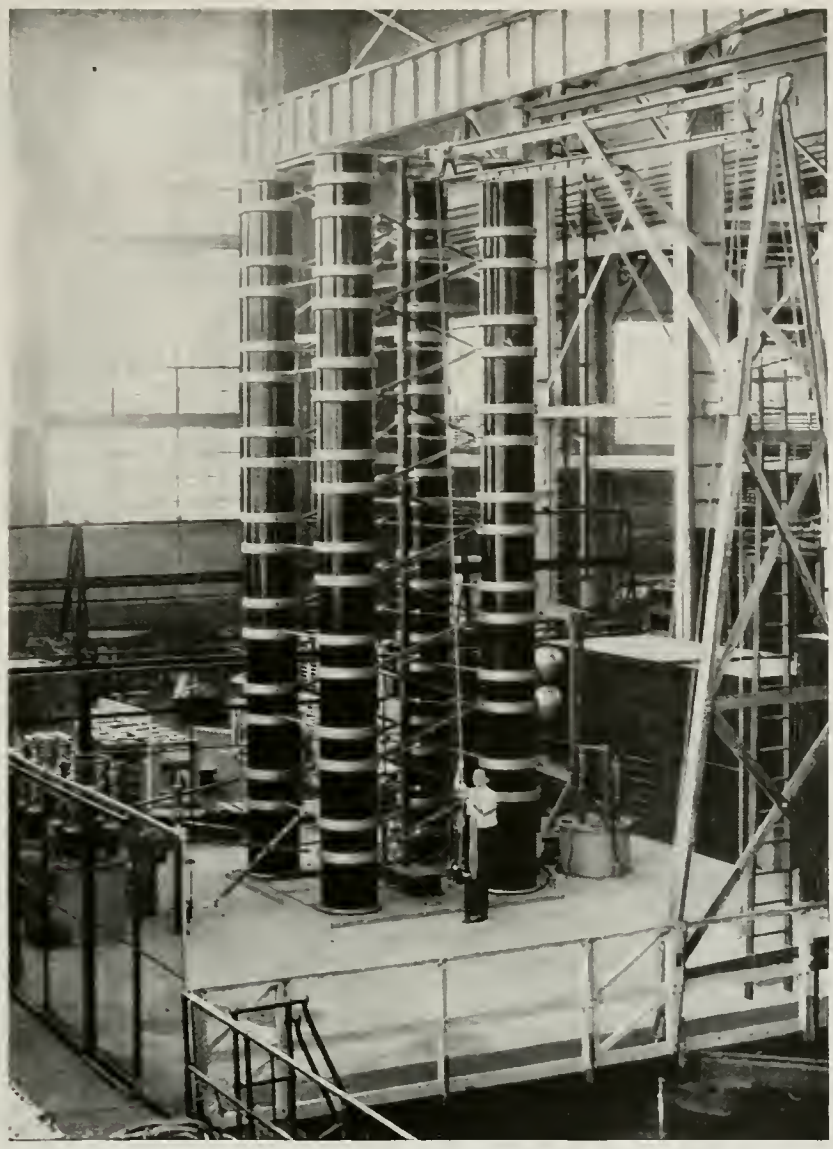


★

Here are some of the different types of gears and pinions used to translate the high rpm speed of the propulsion turbine into slower, efficient propeller speed. Workman is directing overhead crane removal of a high-speed gear blank to a hobbing machine that will cut teeth into its circumference. Larger gears shown are low-speed, or "bull," gears manufactured at a General Electric plant.

★

—Cut Courtesy General Electric



FOR TESTING POWER TRANSFORMERS. Excellent flexibility, greater stored-energy capacity, and streamline appearance are afforded by the 3,000,000-volt impulse generator now used in power-transformer test by the General Electric Company at Pittsfield, Mass. The main generator consists of 100-kilovolt capacity units arranged in four vertical stacks, with the elements electrically connected for a maximum charging voltage of 200 kolivots. The motor-operated switching spheres are mounted in two vertical Herkolite columns at the center of the main assembly.

Cut courtesy General Electric

The 128-foot television transmitter of G.E. station WRGB with an enclosed electric heater.

Cut Courtesy General Electric

USING HIS HEAD. Old skills such as the "head-toting" method demonstrated by this workman at the Westinghouse porcelain plant are being used today to speed production. Skillfully balancing a 20-pound high-voltage insulator on his head and another in each hand, he easily walks a few steps with them to the conveyer that carries the porcelain insulators to the kilns. Workmen at this plant learned the head-carrying method more than 15 years ago, before automatic conveyers were installed. The insulators shown are for condenser bushings to insulate high-voltage wires attached to such electrical apparatus as transformers and circuit breakers.

Cut Courtesy Westinghouse

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further American Good Living . . .

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Dr. Serge Koussevitzky

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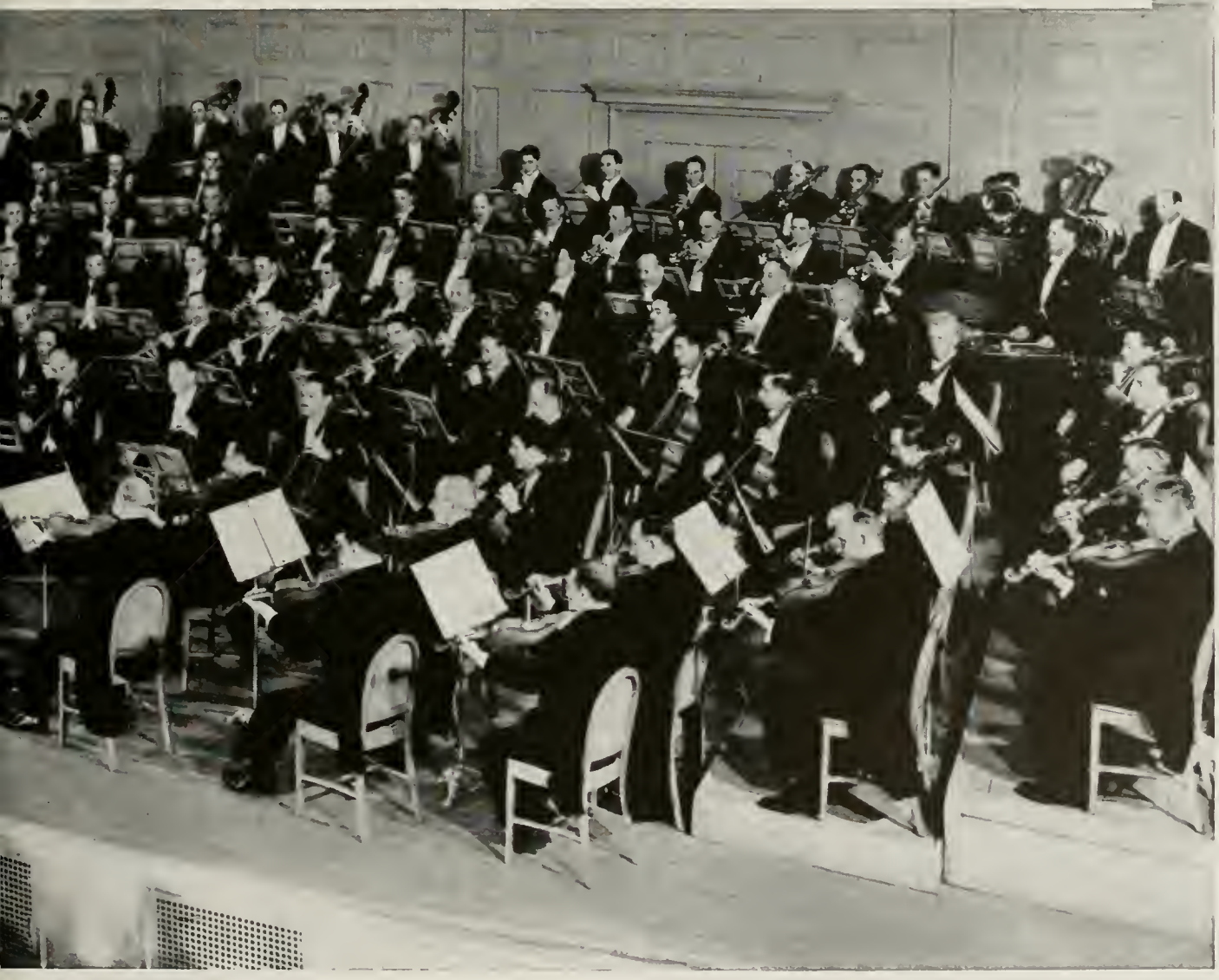

ALLIS-CHALMERS

ELECTRONICS *at* WORK

By CARL J. MADSEN

Electronics Engineer, Industry Engineering Department,
Westinghouse Electric and Manufacturing Company,
East Pittsburgh, Pa.

To many people the word "electronics" still carries with it the atmosphere of strange imaginary worlds, assorted elliptical orbits, weird atomic structures and other mystifying figures. To others, it conveys radio broadcasting and television. However, to those associated with the science of electronics for over a decade, this mirage is replaced by the mental picture of thousands of electronic devices in every day use in our factories, mills, offices and homes.

There are probably as many definitions of the word electronics as there are individuals associated with its application. One definition is: electronics is the application of devices in which the flow of free electrons are made to perform such numerous functions or duties, as to rectify, amplify, generate, control, convert light into current and current into light. The necessary tubes may take the form of diodes, triodes, ignitrons, pentodes, beam power tubes, thyratrons, phanatrons, kenatrons, photo tubes, cathode ray tubes and so on. A brief study of the application of these hundreds of types of tubes shows that the science of electranics is not new. It also shows that the future possibilities are extremely important in that hardly a week passes without the development of new types or new combinations of tubes and circuits to perform new functions.

Early activity with electronic tubes led to the creation of radio station KDKA, the pioneer of our present day broadcasting. The development by Westinghouse of high-power, air-cooled, radio transmitters, made possible by high-power, air-cooled electronic tubes, undoubtedly aided in the development of high-power tubes for use in Radar equipment. But the activity was not confined alone to the broadcasting field as shown by a number of important Westinghouse contributions such as Ignitron tube, Weld-O-Trol, Ignitron welding timers and numerous electronic control devices used in many of our industries today.

The developments of electronics can best be explained by breaking down the applications into these nine classifications.

Rectification
Inversion
High Frequency Heating
Communications
Measurements
Control
Inspection and Sorting
Precipitation
Radiation

There are two fields which have been important in past years in rectification. The first is power rectification. The second, high voltage rectification, is important in that it is frequently employed as a means to an end in many other types of electronic equipment, such as, power supply for high frequency oscillators, Radar, communication equipment, measuring equipment, and our broadcast receivers and transmitters. Rectification will have an important position in most of the electronic devices which may be developed in the future because of the nature of electronic tubes.

At the present time relatively little work has been done in the use of inversion principles. A few particular applications in the conversion of 25 to 60 cycles and vice versa have been made. However, the use of inversion will become increasingly important to a number of industries in the future as a source of variable-frequency, a-c power which provides a means of variable speed control for drives employing a-c motors. It should be extremely useful in the operation of certain high-speed machine tools for variable-speed control.

High frequency heating was the subject of much experimental work more than ten years ago. Experiments were conducted at that time in the heating of various materials such as plastics, bonds, food, metals, cements and for the extermination of bugs and larvi. Excessive cost caused by misapplication or misunderstanding of some of the limiting factors proved some of these applications unpractical. However, a number of these applications have been brought to the fore-front recently and will undoubtedly become increasingly wide spread in their application in the future.

Some of the present applications employing dielectric heating are the bonding of plywood and the heating and curing of plastic materials. Dielectric heating has its important application where thick sections of plywood, thermoplastic or thermo-setting materials are involved. The development of thermo-setting bonding materials now permit fabrication of thick sections of plywood in the matter of three to five minutes. Hours were required with steam or other form of heat. The same is true in the heating and curing of plastics. In addition to speed, the electronic method does a more thorough and uniform job. High frequency heating is bound to have an important position in the future in both plastic and plywood industries.

Another important phase of high frequency induction heating is used in the heating of metals. With this method, faster and more uniform heat treating, anealing, brazing, welding, soldering and tempering has been made possible. In some cases, time has been reduced from 2 minutes to 5 seconds. It is possible, by proper choice of frequency and equipment, to case harden desired surface of mechanical parts, such as, gears and shafts and leave the base metal tough and malleable.

The conservation of tin in making tin plate was made possible by the application of induction heating. Tin plate is produced at speeds approaching 1000 ft. per minute. Here high frequency power in a single plant equals the total power of all our conventional broadcasting stations, and the total installations will soon be over 2½ times this figure. It is only a year ago that the early experiments were made on tin plate.

To date, induction heating has been limited primarily to those particular applications important to our war program. After the war is over and the limiting restrictions of supply have been removed, hundreds of new high-frequency heating applications important to the steel, aluminum, and tool and general manufacturing industries will be found for electronics.

In the field of communication considerable prophecy has already been made by many leading authorities on frequency modulation, television and broadcasting. Important developments in the past year or so will lead to vast expansion in the number of frequency modulation and television sets.

Even in our present broadcasting field the trend of ever increasing power leads us to predict the building of "superpower" broadcasting stations of 750,000 to 1,000,000 watts output.

Carrier current transmission, a less known phase of communication, has found increasingly wide application in the past few years. Its use in connection with protective relaying has permitted the capacity of our present power lines to be increased over 50 per cent, with a comparable saving in vital copper and other critical materials. Telemetering, or the remote indication of circuit and plant loading to a central dispatcher in the power distribution system is another application of carrier current developments. This application facilitates the economic operation of power generating systems. As the power needs of the country grow, this industry will find some of the war time developments in electronics ready to assist in their problems.

In the field of electronic devices for making measurements, a number of developments have been made in the past few years. These developments include dynetric balancing, the electron mass spectrometer, cathode ray, stroboglow, micrometers and many others. Dynetric balancing is highly important today as it measures and locates the position of off-balance components of all types of rotating parts from the tiny aircraft instrument gyros weighing less than a quarter of a pound, to the massive marine gears weighing over 80 tons. In the conventional sizes, rotors weighing from ½ pound to one hundred pounds are often balanced in less than 15 seconds. Former methods required more than one hour. Off-balance components producing vibrations of as low as three thousandths of an inch can be accurately measured electronically and the position for a balancing weight located within two degrees. This development will be of increasing importance in years to come in helping to build longer life machines with quieter and more dependable operation.

The electron mass spectrometer, developed by Westinghouse, is a device for the rapid analysis of chemical compounds. At the present moment its most useful application appears in the petroleum and synthetic industries where hydro carbons and other compounds associated in the production of synthetic rubber and motor fuels require close control. At the present time samples equivalent to 5 cubic centimeters at atmospheric pressure are qualitatively and quantitatively analyzed with an error in accuracy of less than 1 per cent. More important is that these analyses are often completed in less than 15 minutes where former methods often took at least a day. The mass spectrometer will be adaptable to many other industries in the future as a means of close control in critical processes. It is even possible that the principles of the mass spectrometer may be extended to the actual production of rare elements.

A few other electronic measuring devices made by Westinghouse are cathode ray oscilloscopes, stroboglow, speed indicators and micrometers.

In the field of control apparatus Westinghouse has been active for many years producing electronic lighting controls, photo-electric devices, smoke recorders, resistance welding controls and motor speed controls. In resistance welding Westinghouse is at present producing many welding timer units for use in plants welding vital plane parts. As new technique in welding procedures are established, welding control and sequence timers will play an increasingly important part for these operations.

A rather recent development has been the Mot-O-Trol, an electronic device which permits the operation of d-c motors from an a-c power source. With a wide range of speed control, good speed regulation and current limiting acceleration. The speed is controlled with precision from a remote pushbutton station that permits the operator to maintain instant control at all times. At present, it is built in sizes up to 15-hp, with larger ratings probably soon to come. In machine shops and the machine tool industry this means increased production and superior products. Other devices such as register regulators, voltage regulators and speed regulators will become common practice in the printing, steel and paper mill industries.

Many types of electronic equipment have been developed for use in the inspection and sorting of products in a diversified group of industries. Industrial x-ray, for instance, is a present applied for the inspection of armor plate, welds, airplane parts and other equipment, spotting certain defects which might otherwise escape notice. In peace time the advantages of this type inspection may result in safer, lighter automobiles, trucks and planes as unnecessary safety factors for unseen defects can be avoided.

Photo-electric devices in applications such as pin hole detectors permit the rapid inspection and automatic sorting of prime and defective sheets. Defects which often escape visual inspection are spotted faster than the combined work of a dozen employes. Simple operations such as high speed counting and the control of conveyor lines are applications which are in operation today, but which undoubtedly will be extended to many other industries in the near future.

The precipitation of dirt and dust particles, fumes and smoke has had an important place in a number of industries, such as film processing laboratories, precision instrument factories and arsenal plants. In the machine shops a Precipitron has removed as much as 4 gallons of oil a day from the air surrounding a high speed lathe, oil which otherwise settles on the lights, walls and equipment as well as in the lungs of the workmen. It is quite probable that a Precipitron for the home will soon be available to remove irritating pollens as well as dust and germs from the air which we breathe. Even the smoke from combustion gases may be removed from our chimneys to make our homes and communities cleaner places in which to live.

Light radiation is sometimes questioned as to its position in the electronic field. Fluorescent lights producing more than twice the number of lumens per watt than our filament incandescent lamps are being used in increasing quantities in factories and homes. A slight variation of the same principles of operation may be more important in our daily life than the fluorescent light. This device is the Sterilamp, a source of ultra-violet radiation that has the property of destroying many types of bacteria. The demand has been so great that production has been unable to keep pace. Its applications are so universal that it is not improbable that our homes, refrigerators, laboratories, meat storage and curing vaults, food processing and handling industries, public meeting places and so on will be completely equipped in the future.

Radar, the great development of this war, will have many applications to the transportation industry when the demand for military equipment has passed. Our planes will fly in greater safety, our liners dock at their berths without delay even though fog shrouds the course to be covered. The location of every mountain, plane, boat or rock within the danger area will be instantly known to the controlling personnel. It may be used on railroads, reducing the hazard of collisions.

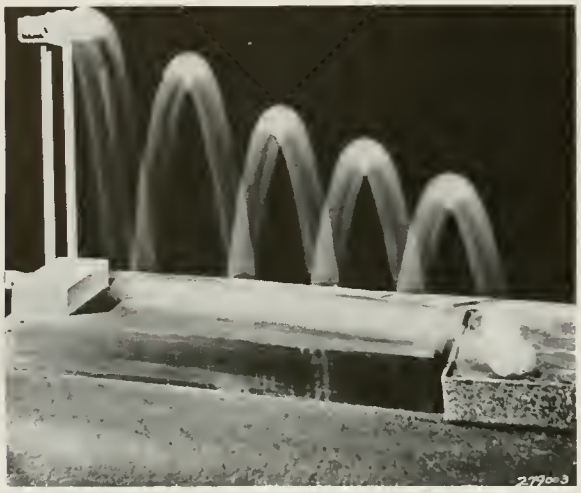
It is not possible to anticipate all the future developments made possible by electronics. The possibilities are beyond imagination. However, many applications exist where electronics can do the work better than other types of equipment, do some things not possible in any other way. But electronics cannot do everything. Many possible applications are not economical or practical. With electronics now on the tip of every tongue it is essential that every experienced electronics engineer weigh carefully every request; every possible application to avoid misapplications which may lead to delay in acceptance on jobs it can do well.

(Continued on Page 27)

THE MAGNETIC RELAY . . .

(Continued from Page 9)

nating from positive to negative, thereby causing the armature to tend to return to its non-operate position. C. P. Clare & Co. use a copper disk on the armature end of the relay to hold the armature in the operating position when the current goes to zero. The holding force is proportional to the square of the flux density, so that when the current



Comparison of solid metal ball to one filled with metallic powder.

goes to zero, the eddy currents in the copper disk tend to produce the flux necessary to hold the armature in its operated position.

Relays are very swift-acting devices. Many factors affect the operating time of a relay; the greatest factor being the electrical time lag. By operating time it is meant the time necessary for the armature to move from its non-operate position to its operating position, or the time necessary after the coil circuit has been closed to the time the contacts make or break. C. P. Clare & Co. have found that for a certain type of relay, the operating time is .012 seconds. The armature movement is completed in .002 seconds; the remaining time, or .010 seconds, is necessary for the flux to build up to the point where the armature starts to move. The electrical time lag is due to the inductive reactance of the coil, which is generally increased when the number of turns on the coil is increased. However, the ratio of the inductance to the resistance determines the rate of build up of the current when the coil circuit has been closed, if the iron core losses and the saturation are neglected.

Sometimes it is necessary to use resistance and condensers, or other spark suppressors when a highly inductive load is

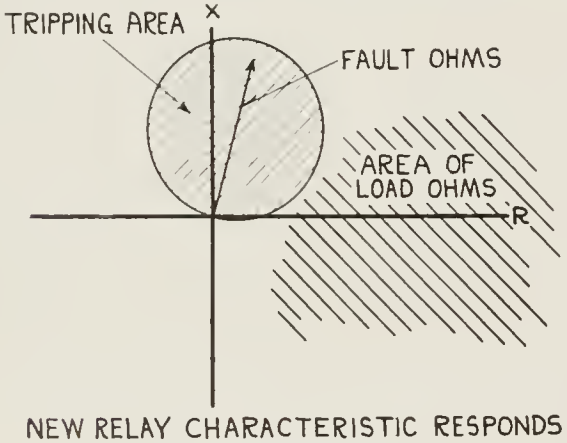


Fig. 2

used. Such suppressors are used to dissipate the energy that is stored in the magnetic field. No general rule can be formulated as to the magnitude of the resistances and condensers that are connected in series across the contacts, as each circuit must be considered individually in arriving at reasonable values.

A new type of relay has been designed by Westinghouse Research engineers to protect heavily-loaded long transmission lines. A relay of this type must be able to discriminate between a load impedence and a fault impedence. By this it is meant that a relay must be able to distinguish a legitimate load from a fault. (See fig. 2). Normally the fault impedence is not as great as the load impedence, so that the relay has no difficulty in distinguishing between the two kinds of loads. With wartime loads, when power loads are greater in a shorter circuit, a new type of relay had to be adopted that would not operate on surges that did not upset the circuit-synchronism. However, the relay must be able to trip a faulty circuit. By trip, it is meant that the relay would interrupt an overloaded circuit and thus avoid serious consequences.

The new difference in design is based on the principle that load currents on long lines are usually near unity power factor, while fault currents normally lag by sixty degrees or more. The relay thus designed will not only recognize the magnitude of the impedence, but the impedence phase angle as well.

The General Electric company have patented a time-delay mechanism that incorporates the use of a relay. The mechanism includes a vacuum tube, a potentiometer, a transformer, and various resistances and condensers. The potentiometer determines the time lag by determining the energizing of the relay. The vacuum tube acts as an amplifier tube.

There are several types of overload relays for the protection of A. C. induction motors. The principle employed here is that metals expand when heated, either

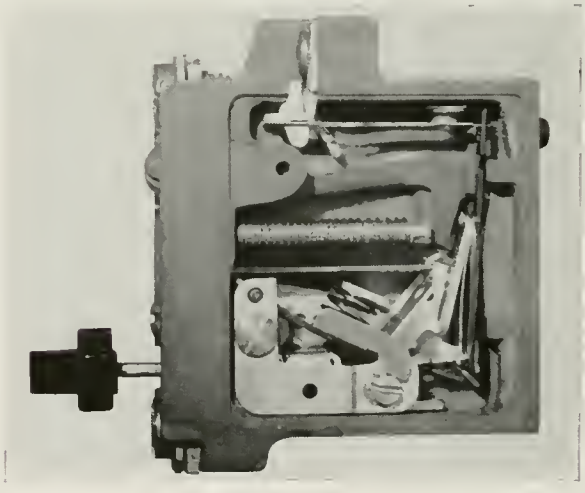


Fig. 3

by resistance or inductive heating. The expansion element can be low temperature solder, bimetal strips, or simply an expansion metal. (See fig. 3). The coil of the relay produces the heat that causes the metal expansion, thereby tripping the relay and protecting the motor. The time-current characteristic is largely dependent upon the way the heat is transferred to the responsive element and also the thermal capacity of the heat producing element.

Counting relays are becoming increasingly important due to the manpower shortage. (See fig. 4). A photoelectric cell will give intermittent responses to the relay; the relay doing the actual counting. Instead of the armature operating an external circuit when the coil is energized, it operates

(Continued on Page 24)

WAR TOWN BOON!

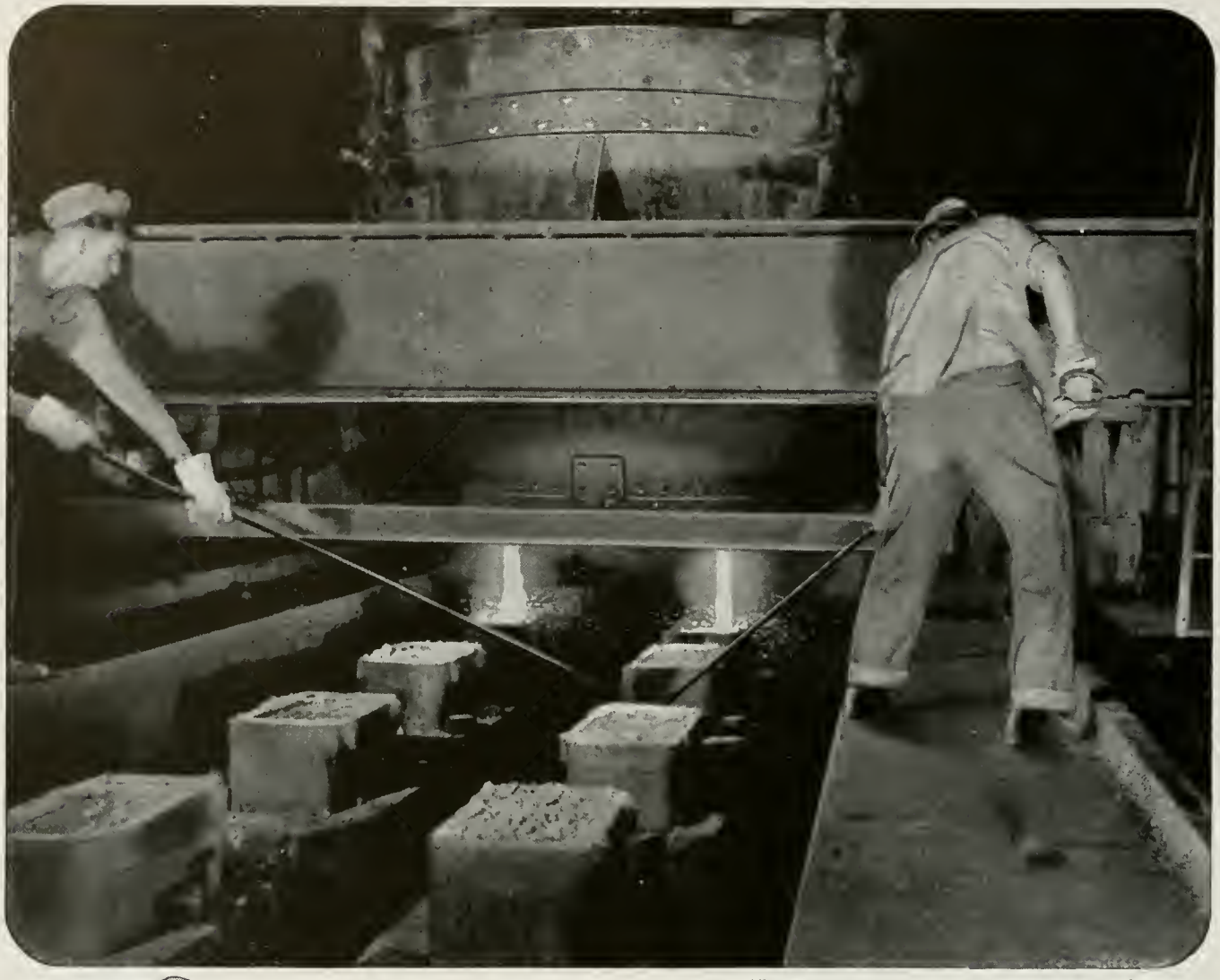
"Community" public telephones—some even in outside booth locations—are serving residents in war-born neighborhoods.

Many such telephones handle several hundred calls every month. It's a way more persons can use the available facilities, limited now by wartime material shortages.

The nation-wide resources of the Bell System are enlisted in maintaining dependable communication services—vital in war, essential in peace.

BELL TELEPHONE SYSTEM

War calls keep Long Distance lines busy . . . That's why your call may be delayed.



O.W.I. Photo by Palmer, in an Allegheny Ludlum plant

STEEL IS FLOWING TODAY THAT WILL BE FLYING NEXT MONTH

ALLOY steel, conceived in the mighty heat of the electric furnace, is just being born when it teems into ingot molds. From here it rapidly multiplies into countless forms and shapes, reaching maturity within a matter of days as parts in finished warplanes, tanks, guns, ships or munitions.

Many of those products will be better, and will perform their war job without fail—thanks to the quality control exercised by Allegheny Ludlum on every batch of alloy steel leaving its mills. It's a rigid control, true, but very necessary to give our fighting men the decisive edge in battle that better equipment assures. And the same close control, coupled with Allegheny Ludlum's research activities—now developing still better fighting steels for our armed forces—will continue after victory is won, to help create better peacetime products for you.

But before there can be peace, we at home must exert every effort to win the war. Collection of scrap metal, salvage of waste fats, conservation wherever possible and regular purchases of war bonds are your contributions from the home front. Only thus can you give the men behind the guns the tools to assure victory.

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★LOW TOOL COST! Standard Carboloy tools, available in 10 styles, 5 grades, wide range of sizes, are priced as low as 70c per tool.

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On aircraft manufacture—as well as in all other industries vital to war—*STANDARD* Carboloy tools have helped point the way towards new economies, new production peaks. These tools—at prices comparable to all other cutting tool materials—are available in 10 styles, 5 grades, for cutting *ALL* metals and non-metallics. Write for new catalog GT-175, just issued.

★ HIGH FINISH! On this steel gear, Carboloy tools produce a finish that eliminates 80% of former hand-polishing needed.

★ EXTRA TOOL LIFE! Machining steel gears for superchargers, Carboloy increases tool life 2800% on eleven operations.

★ INCREASED PRODUCTION! Simply by changing to Carboloy tools, in place of ordinary tools, 86% machining time was saved on this job.

★ EXTRA OPERATIONS ELIMINATED! Tooling with Carboloy Standards made possible the elimination of 4 stations on turret—total of 19 tools saved.

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DON'T OVERLOOK MINING . . .

(Continued from Page 10)

time, but it has been claimed that the United States will not even have enough oil to meet its own needs. Geologists state that from all known geological features most of the major oil pools of the world are now being used, and any new discoveries will be in places either at present inaccessible, smaller in size, or else quite removed from the major markets.

However, that time is not today and until that time this competition must be met. This calls for much research, and several branches are open. For instance, in the above-mentioned case of the clean heating units, there is a need for a compact unit which is both clean and trouble-free. There have been steps made in that direction, but at present they are rather expensive and need more work and salesmanship to reduce their cost. During the past decade stokers have come to the fore, with the greatest sales, by far, in Illinois. Stokers require a uniform size and clean fuel. In order to meet this growing demand the coal companies are being forced to invest thousands of dollars in building modern preparation plants. These are a far cry from the old hand-picking of refuse and shaker-screens for sizing. They require trained men and because they are new there is a lack of suitable men to operate them.

During the past few years the mines of Illinois have been having quite a battle with the city of St. Louis over smoke abatement. Everyone recognizes that smoke is unpleasant and development of means of eliminating it offers opportunities galore. Smoke going out the chimney is equivalent to burning money as it is heating value that is paid for but not utilized. Any gain on this point is two-fold: the customer saves money, and the seller gains a satisfied customer.

It was mentioned above that there is a predicted future shortage of oil. If this is so then there must be a substitute for gasoline and other fuel oils. What better place is there to turn to than the great reserves of coal? Coal is a compact bundle of Btu's and with an extension of organic chemistry and carbon derivatives there are vast openings. Germany and England have already done research along this line of liquid fuels, but only the minimum of possibilities have been surveyed.

Liquid fuels are not the only chemical derivative of coal, though. Tar and asphalt are so common with all their uses and possible uses that it is unnecessary to list them. Already the list of coal by-products is so long it is practically impossible to name all of them; dyes, saccharin, explosives, medicines, and flavoring extracts to mention a few. This list can be enlarged, and each of these can be made more important by careful salesmanship. Research here is unlimited.

Another of the competitors of coal as a fuel has been gas, and yet it would seem that gas is in reality not a competitor, but an ally, and people connected with gas are quite agreeable to co-operation with coal. Most of the domestic gas in use today is obtained as a by-product of coking processes, or else the reverse is the case with coke being obtained while making the gas. Here are two profits in one with the waste product being as valuable as the desired product, and *both are gained from coal.* If either of these increase in size and importance the increase is necessarily reflected in coal. And both of these offer favorable outlooks. Gas is the most instantaneous method of obtaining heat and offers no ash problem. Coke is the efficient method of burning coal. Smoke is eliminated, and ash is at a minimum. It is still the ideal fuel for smelters, offering both heat and reducing action, and the demand is increasing as the steel mills expand.

The other large competitor of coal is electricity and its advantages are undisputed. But here again, the competitor is not of the cut-throat type, but is, in reality, a customer as their executives hasten to assure. Despite the large hydro-electric plants in operation the greatest amount of electricity developed today is developed through steam turbine sets. So, once more, if the competitor grows, coal grows too.

However, coal cannot sit still and expect these benefits to accrue without any effort on its part. This is where the opportunities on technological research enter. For instance, railroads are the greatest customers of coal. This is the most well-known type of steam engine, but the steam engine has many other uses. If work were done in developing a new design that would raise the efficiency only a small amount, this greater efficiency coupled with the other advantages of the steam engine would make it almost a "must" to industry, diesel engines notwithstanding, and new uses would result.

With a reasonable amount of intelligent research all these factors can combine to push coal to the front again, but this time the industry will not be a seasonal occupation for heating fuel only, but will be a stabilized, all-year-round business with many markets available.

Thus mining offers by its research a chance for electrical engineers, metallurgists, mechanical engineers, and chemists. This is what makes mining engineering such an intriguing study. The mining engineer must be all of these combined, together with a knowledge of civil engineering, and yet distinct from all of these he has the science of mining. His is not a positive science in which he can apply a set of rules and know positively what the answer will be. He is working in the heart of the earth with its many unknowns and often unpredictable actions. He must combine technical knowledge with clear reasoning, past experience, and good judgment and attempt to determine the best course of action to take. Because he never encounters the same situation twice there is no monotony or boredom to his job. And the mining engineer that enters the phase of actual mining will be the one to gain most from all the aforementioned expansions. Here is offered an excellent chance to get in on the ground floor while there are still shortages of trained mining engineers and before this boom occurs; and mining and its allied researches are to be recommended to those looking for something with a growing and steady future.

Don't overlook mining!

THE MAGNETIC RELAY . . .

(Continued from Page 20)

a counter fastened to it. A relay of this type may count as many as one thousand articles per second, sort different types of articles, or limit the operations.

Another time-delay mechanism for a relay that does not necessitate the use of vacuum tubes or other external devices, is incorporated in the relay itself. The length of the coil is shortened and a copper slug is used on one end of the coil, its size and position depending upon whether a slow operate or slow release is required.

If the current passes through the coil first, the copper slug generates a counter EMF which opposes the original change in the magnetic circuit, or when the circuit is opened, the counter EMF tends to maintain the magnetic field which in turn gives slow release characteristics. However, if the current posses through the copper slug first, the counter EMF opposes the increase in the magneic field and therefore gives slow operation. In either case, a time-delay factor is introduced.

The relay today is being used in electric alarm systems to protect our war plants from sabotage, in our bombers to open the bomb-bay doors, in our modern dial-telephone systems, in remote control, such as the automatic pilot on airplanes, in automobiles to prevent the storage battery from

Your Tomorrow Began Yesterday

Yesterday someone did something that will make tomorrow better.

We do not mean to be Pollyanna. We are totally engaged in the grim business of producing for war. But it is still hard, realistic fact that the good things of tomorrow are being planned today, were planned yesterday. Jobs, for instance. Your future job.

This is one reason why we enjoy working with aluminum. It's full of possibilities for making new things, and making old things better. The future of aluminum is exciting.

There is now much more aluminum and it costs less. It will be usable in many more places. Alcoa has been imagineering in aluminum for 54 years and we have good reason to feel the postwar future of aluminum is something for a man to want to have a part of.

Look what aluminum can do to help patch up this shattered old world. It's the wings of the Air Age. It is going to tie remote peoples together and help bring about understanding.

Aluminum's strength with light weight makes things easier to lift, less expensive to move. It offers another spurt of growth to all forms of transportation.

Alcoa Alloys in brilliant colors promise a new splurge for beauty. Think what you can do to brighten homes and hospitals, stores and schools with a metal that is easy to work, resistant to corrosion, light, strong and capable of being dyed practically any color of the rainbow!

We have seen a lot of good imagination engineered into plans utilizing Alcoa Alloys. We have done some Imagineering of our own, too.

These plans are today's blue-prints for tomorrow's jobs. Many of you younger men will be needed to turn them into action. In fact, we hope some of you will want to help put across the ideas we have been cooking up here at Alcoa.

A PARENTHETICAL ASIDE: FROM THE AUTOBIOGRAPHY OF

ALCOA ALUMINUM

• This message is printed by Aluminum Company of America to help people to understand *what we do* and *what sort of men* make aluminum grow in usefulness.

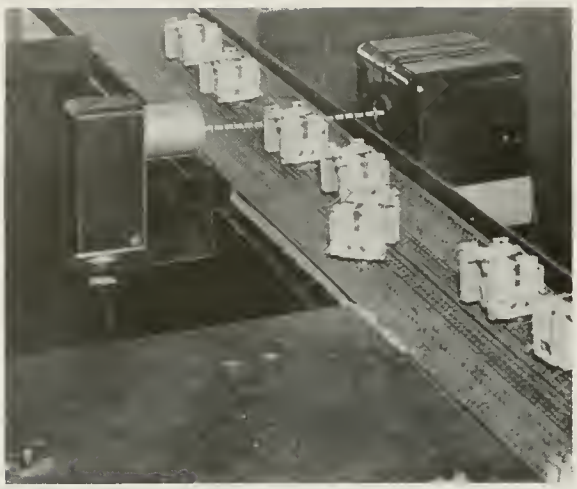


Fig. 4

being overcharged, in conjunction with the phototubes for counting, sorting and limiting operations, in cosmic ray counters to determine the number of rays that can penetrate a dense substance in a given time, and in nearly every electrical device that is to be operated by the principle of induction and that utilizes small currents.

In many instances the electron tube operations would not be possible without the aid of the relay and yet the electron tube receives all of the glory. The electronics field is the most highly publicized, but the electromagnetic field must not be forgotten when the victory is ours and the credit is given for the inventions that helped us to win.

COMPREG . . .

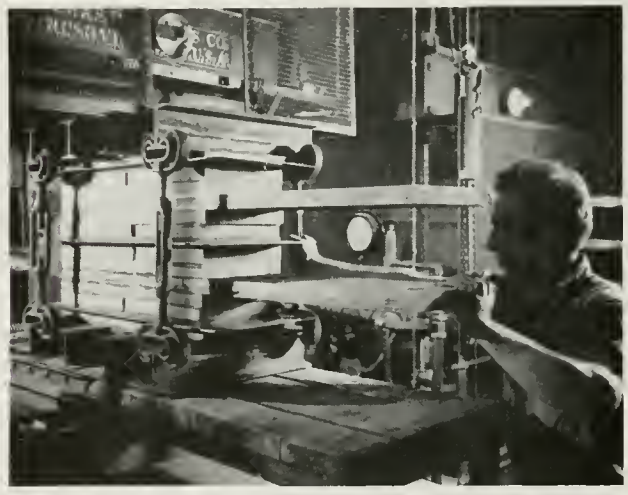
(Continued from Page 13)

to the maximum obtainable under very high pressures. (2) Resin holds the plies of wood together. The remarkable adhesive quality of the plastic resin is especially important in such applications as propellers which are composed of as many as 100 plies, the failure along any one glue line causing a failure of the whole unit. (3) Resin bonds the wood fibers so that the wood gains strength in the crosswise direction. However, results are not as good as had been anticipated, and at present the only positive way of securing uniform strength in the cross-wise and length-wise directions is to lay the wood veneers so that adjacent plies have their grain directions perpendicular. (4) Resin retards the rate of moisture absorption. Sufficient impregnation with high plastic content makes the wood almost impermeable. (5) Resin has a real effect on the ultimate properties of the wood. Tendency to swelling, shrinkage, and buckling is markedly reduced. For example, untreated birch wood loses about 50% of its compressive strength when its moisture content is increased from 3% to 16%, but resin impregnated birch maintains its original strength very well. (6) Resin increases hardness of the material which enables it to be more easily machined and more impervious to wear and abrasive action. (7) Resin tends to embrittle the wood considerably, showing very little elongation and cast iron-like failure when stressed beyond the ultimate.

In view of the aforementioned characteristics, compreg

Assembly of impregnated wood lamination to produce 1¼ in. thick compreg panels. Four panels pressed in each opening of 10-opening hydraulic press.

Assembly of 1¼ in. compreg panels to produce desired thickness at hub of propeller. Note metal plates which serve as electrodes in electronic heating.



Compreg propeller blocks being loaded into veneer press.

has found its way into many wartime applications and offers considerable possibilities for postwar use. The most notable and extensive use of compreg is in aircraft propellers. This application is a high compliment to compreg since the propeller is one of the most highly stressed units of the airplane structure. In this country compreg propellers are used primarily in training craft while the British have used in their fighter craft with good results. The primary property of compreg which makes it applicable to propellers is its high tensile strength which has been reported above 45,000 pounds per square inch (duralumin has a tensile strength of approximately 25,000 psi). The laminated propeller also has a high damping capacity, or great vibration absorption ability, which in turn, provides cushioning for the motor.

Because of its hardness and resistance to abrasion, compreg is especially suited for counter and table tops. Its dimensional stability dictates its use in better class homes for doors and windows. Station wagon body panels, boat decking, skis, and furniture are just a few of the many peacetime possibilities of compreg.

Band-saw trimming to size ready to be shipped to propeller manufacturer.

At present the only factor which will deter its widespread use is its high cost of manufacture. It is hoped, however, that with increased volume of production and new techniques of manufacture, compreg will be able to compete with other materials on a cost basis.

Bibliography: "Resin Impregnation of Wood," by R. Casselman, *Modern Plastics*, November, 1943.

ELECTRONICS . . .

(Continued from Page 19)

The vast production capacity developed to meet present war time requirements will place electronics in the position to serve the needs of the post war world, but our development effort and production facilities must be used wisely. It is important that we "keep our feet on the ground" lest the electronic field again be smothered by adverse publicity caused by misapplication. Westinghouse has and will continue to contribute to the expansion of electronics and its application to the service of man, keeping "Electronics at Work."

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TECHNOCRACKED

"You certainly are well-preserved for your years."
"Well, why not. I get canned at every place I work."

* * *

"So your brother's a painter, eh?"
"Yep."
"Paints houses, I presume."
"Nope, paints men and women."
"Oh, an artist."
"Nope. Just paints Women on one door and Men on the other."

* * *

She was the only the income tax expert's daughter, but her form was properly filled out.

* * *

Shipyard interviewer: "Have you had any experience in defense work?"
Girl Applicant: "Sure, I used to date a V-12 at Illinois."

* * *

WCTU Lecturer: "Here's an argument from nature. If I lead a donkey to a pail of water and to a pail of beer, which will he drink?"
Any Illini: "The water."
Lecturer: "Right. Why?"
Illini: "Because he's an ass."

* * *

We're broom-mates
We sweep together
Dust we two

* * *

"Is your mother home?"
"No, come right in."

* * *

Prof.: "How did they ever find iron?"
Met. E.: "They smelt it."

* * *

"How much did you spend on her last night."
"Between nineteen and twenty dollars."
"Oh, I see. A dollar."

* * *

"So he's going to college. What is he taking up?"
"About everything that isn't nailed down."

* * *

"I suppose you've been through algebra."
"I went through at night and didn't see the place."

* * *

"I'm a big gun at college."
"Then why don't I hear better reports."

* * *

Sign in a real estate office: "Get lots while you're young."

* * *

Market report: "Poultry is up two cents a pound, but live pigeons continue to drop a little."

* * *

We have a deep respect for age, if over 8 years and bottled.

* * *

The bus driver charged a lady full fare (10c) for her son. He had on long pants.

At the next corner a small boy wearing short trousers paid only 5c (half fare).

At the next corner a lady mounted the bus and he didn't charge her anything. Why?

You have an evil mind—the lady had a transfer.

* * *

Cursing and yelling on a London street was Clancy holding a doorknob in his fist. "Them damn Nazis will pay for this—blowin' a saloon right out of me hand."

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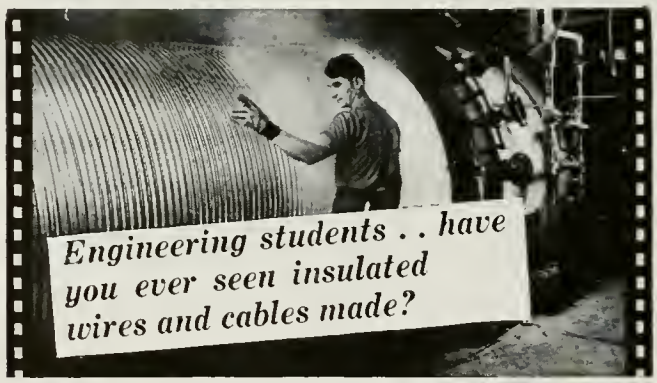

3303

It isn't necessary to visit a manufacturing plant to see how they are made and installed. The Okonite Company has motion pictures available, which we will be glad to furnish without charge at the request of any responsible organization. For instance:

"Rubber Insulated Cables" – Sound film, showing the manufacture of rubber insulated wires and cables from the raw material to the finished product. Narrator: Lowell Thomas. Projection time: 25 minutes. In 16 mm. and 35 mm. sizes.

You can arrange to have this picture for your next meeting by writing to:

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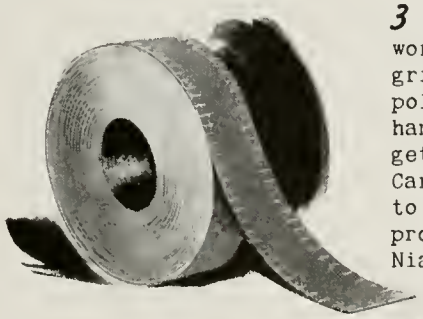
The darndest machine you ever saw...

1 It has an interesting, complex oscillating motion. It works up and down following crank contours. And it does it all at once! It's the darndest machine you ever saw! Yet it is one of the most efficient and productive machines of its type. Its job is to finish all of the bearing surfaces on a crankshaft at one fell swoop! The older method of performing this same operation is to hold the abrasive cloth in a "nutcracker," finishing only one surface at a time.

2 With the new machine, strips of successively finer grits of abrasive cloth, having serrated edges to permit the strips to follow the fillets of the bearings, are automatically inched past the revolving crankshaft from a feed roll of the cloth. And on many a job it's Aloxite Brand cloth by Carborundum that gives the ultimate smooth, satin finish.



3 Carborundum Research is steadily working to improve production through grinding, finishing, sharpening and polishing. It will continue to work hand in hand with industry. When you get into the field, remember that Carborundum Engineers will stand ready to help with your production problems. The Carborundum Co., Niagara Falls, New York.

CARBORUNDUM
ABRASIVE PRODUCTS

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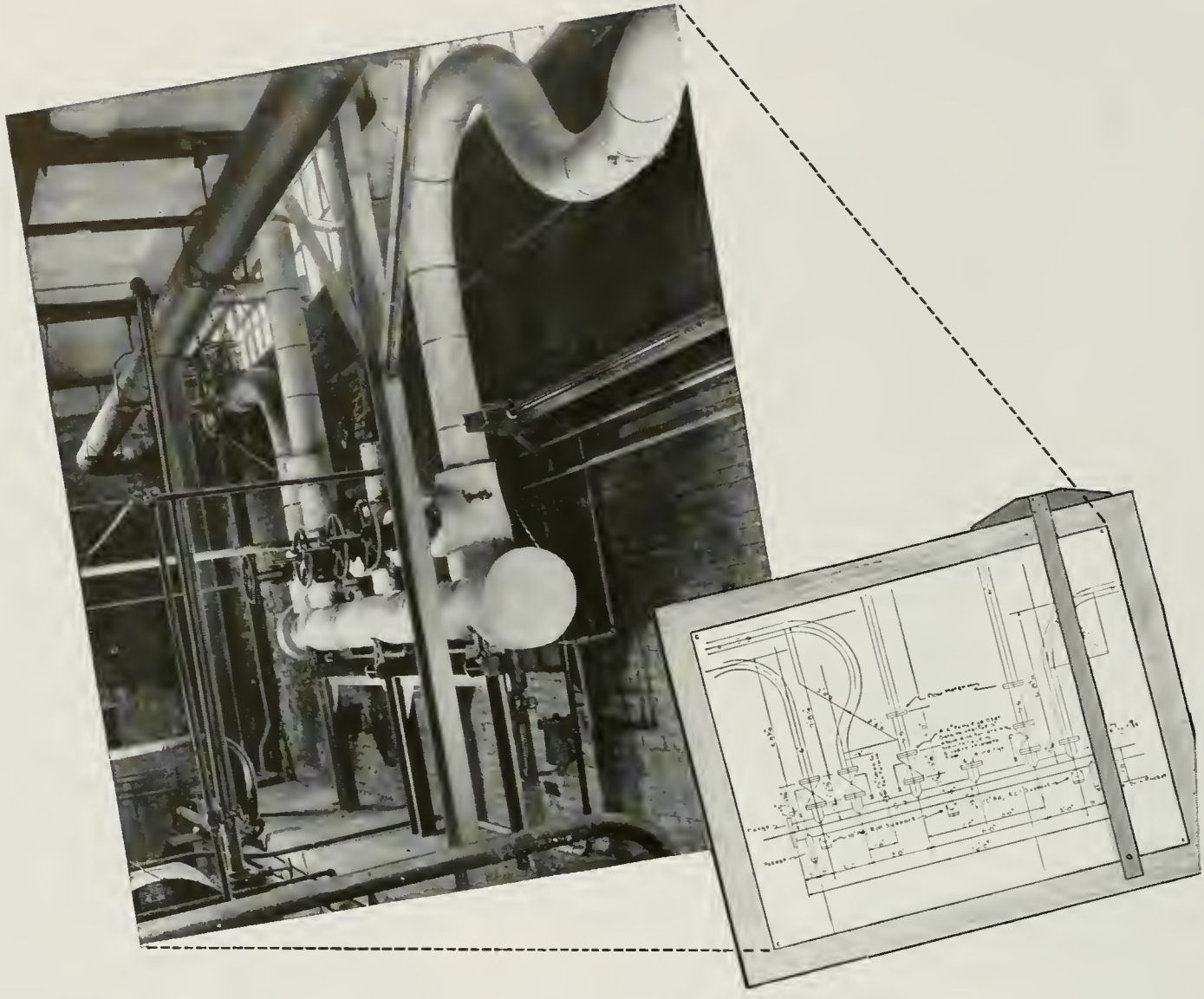


PIPING *is more than a line on a blueprint...*

TRANSLATING a piping blueprint into terms of pipe sizes—kinds of fittings—types of valves will have much to do with determining whether an engineering project is a success or a failure. For almost any project is inconceivable without piping, which controls the flow of air, gas, steam, water, oil or other liquids.

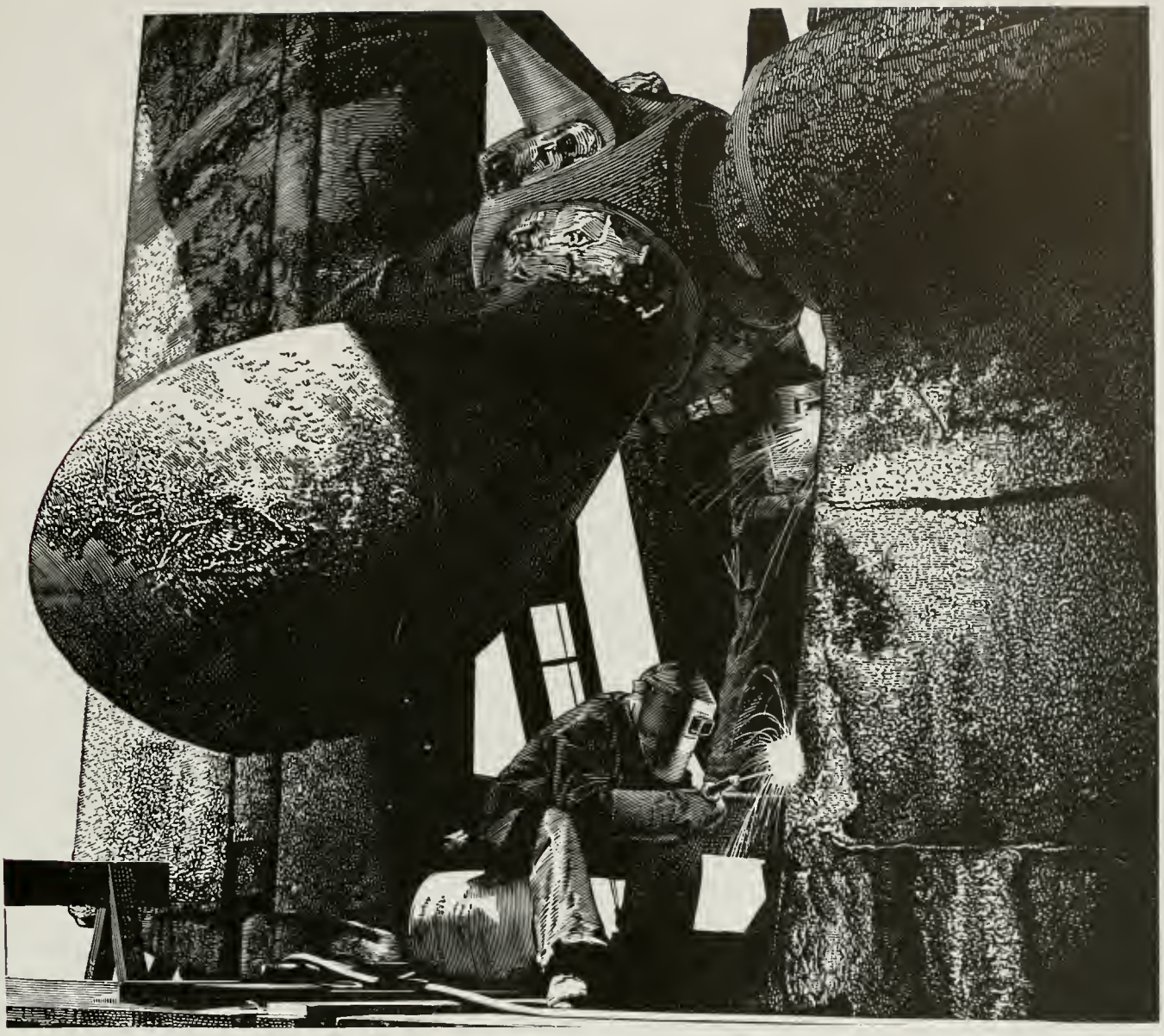
You are probably familiar with the high quality — the precise manufacture — that characterizes valves and fittings made by Crane. You may not know that the Crane line includes equipment for *every need* of *every piping system everywhere.*

Writing "Crane" on a complete piping specification has many advantages to the engineer. First: He knows that every item in the system will come from one source, saving valuable time all down the line from drafting room to final assembly. Second: The project will have a matched piping system—with all parts designed to work together. But, above all, he is assured of the long life and satisfactory operation that come from the exact design and high quality that are a part of every piping item carrying the name Crane.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS



REPAIRING DAMAGED LINKS IN OUR LIFELINES

WITHOUT benefit of ceremonies, American ship repair yards are regularly performing one of the most gigantic and least publicized jobs of the war . . . a task which is vital to maintaining a constant flow of troops and materials over our trans-oceanic highways. As evidence of the scope of this achievement, in 1942 alone American shipyards completed repairs on over 12,000 ships of all sizes.

In this big war job, as in the huge ship construction program, the oxyacetylene flame and the electric arc are indispensable. These speedy modern tools provide the fastest and most flexible method of cutting and joining heavy steel ship plates . . . whether it be for production, maintenance or repair. Similarly in many other vital war industries, the oxyacetylene flame and electric arc have made possible unprecedented production records. Their proven speed, efficiency and versatility in war production foreshadows their increased importance in future peacetime manufacturing.

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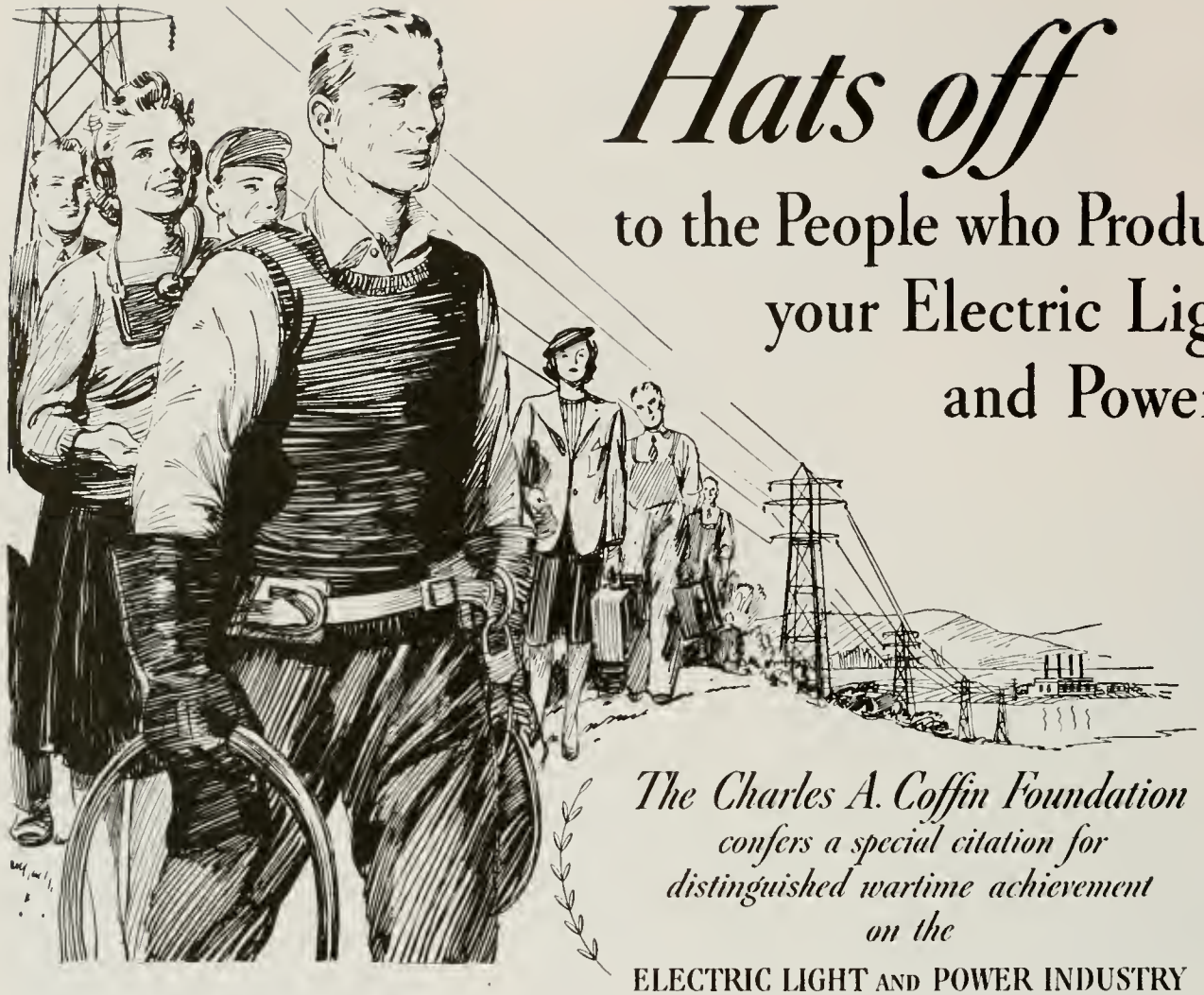

Hats off

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The Charles A. Coffin Foundation
confers a special citation for distinguished wartime achievement on the

ELECTRIC LIGHT AND POWER INDUSTRY

"Faced with unprecedented demands, the Electric Light and Power Industry has met every war-production requirement without delay and without impairment of its peacetime services to the public. This achievement merits the appreciation not only of American industry but of the entire nation." — FROM THE CITATION

THIS CITATION is richly merited—for here is a branch of industry that has done a remarkable war job that has not been generally recognized.

If electric power should fail, or if it be too little or too late, the disastrous effects would startle all America. Vital machines would be motionless. Millions of homes would be cold—and an eerie blackout would descend over the land.

But electricity has not failed. Rather, in 1943 twice as much power was produced as in the year before the war—with the minimum of new facilities—and despite large losses of skilled employees to the Armed Services.

In the words of J. A. Krug, Director, Office of War Utilities of W.P.B., "Power men—public and private—should be proud of the job that has been done in providing power supply. Power has never been too little or too late."

We of General Electric, who have built a large part of the electric equipment which generates, distributes, and uses the electric power of America, take pride in the way this equipment is standing up under the strain of "forced draft" wartime operation.

Many of the men and women responsible for this remarkable record are your neighbors—the manager or meter reader who lives across the street, the girl in the accounting department who is in your bridge club, the lineman with whom you bowled last night. A word of appreciation from you to them will lend added significance to this well deserved citation. *General Electric Company, Schenectady, New York.*

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KEEPING UP WITH *Electricity*

BROADCASTING TIN. "Flowing" tin plate by induction heating is now accepted practice in the industry. Frequency used in the first installation was 200,000 cycles per second—and the equipment was salvaged from a discarded broadcasting unit! Incidentally, this first installation is still in daily use.

IT'S A MATTER OF SPEED. Radium gives out 1,200,000 times as much energy as the same weight of coal burned with oxygen. Even if we had plenty, however, it would probably be a poor substitute for coal, since it releases energy only one-eightieth as rapidly. Nothing that scientists have been able to do has had the slightest effect in speeding up the process.

THE SUN IS STILL SLOWER, releasing energy by a process which involves the transmutation of elements and takes between six and seven million years.

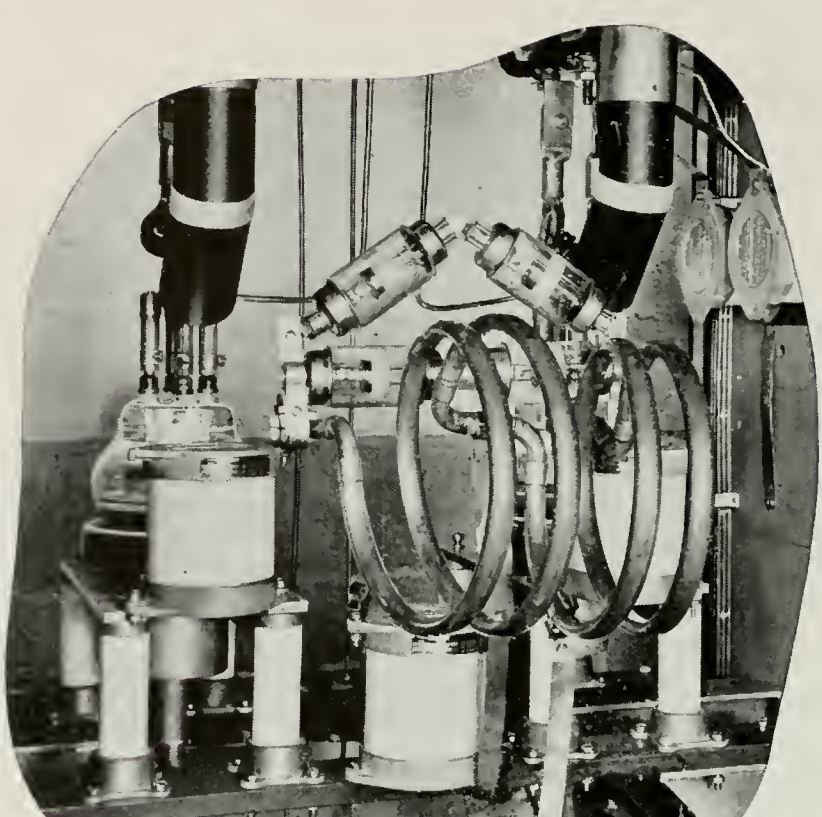
WOMAN'S WEAPON. One reason that electric irons aren't being made is that the thermostats used to control their temperature are busy on land, sea and air. They're guarding against motor trouble in tanks, fire danger in planes, overheating in gun equipment on battleships.

PEAK FLATTENERS. Resistance welders have speeded up production in thousands of war plants, but they have imposed enormous on and off single-phase loads on power circuits, often building up impossible peak demands. Capacitors are proving to be the answer, correcting the power factor to approximate unity.

THE HIGHER, THE FEWER no longer applies in radio vibrators. At high altitudes, vibrator contacts literally "boiled away" in ten hours, hence this type of radio was seldom used in airplanes. New-type vibrator, using Westinghouse-developed materials and techniques, has a life expectancy equal to that of the plane.

• • •

The above items are condensed excerpts from articles in the WESTINGHOUSE ENGINEER, a bi-monthly engineering review. Regular subscription price—$2.00 a year. *Special price to students—50¢.*



Plastics, plywood and electronics

This is a Westinghouse laboratory set-up for research in dielectric heating—internal heating by high-frequency radio waves. Together with induction heating—surface heating of metals by high-frequency radio waves—this process is daily finding new applications in industry.

One outstanding use of the principle of high-frequency heating is the Westinghouse development of flowing of tin on steel strip. Other important applications are in the bonding of plywood and the curing of plastics.

Dielectric and induction heating effect important savings in time and materials with attendant benefits of better control and more uniform results.

High-frequency heating is an example of electronics at work, another phase of Westinghouse leadership in electricity. Westinghouse Electric & Manufacturing Co., Pittsburgh 30, Pa.

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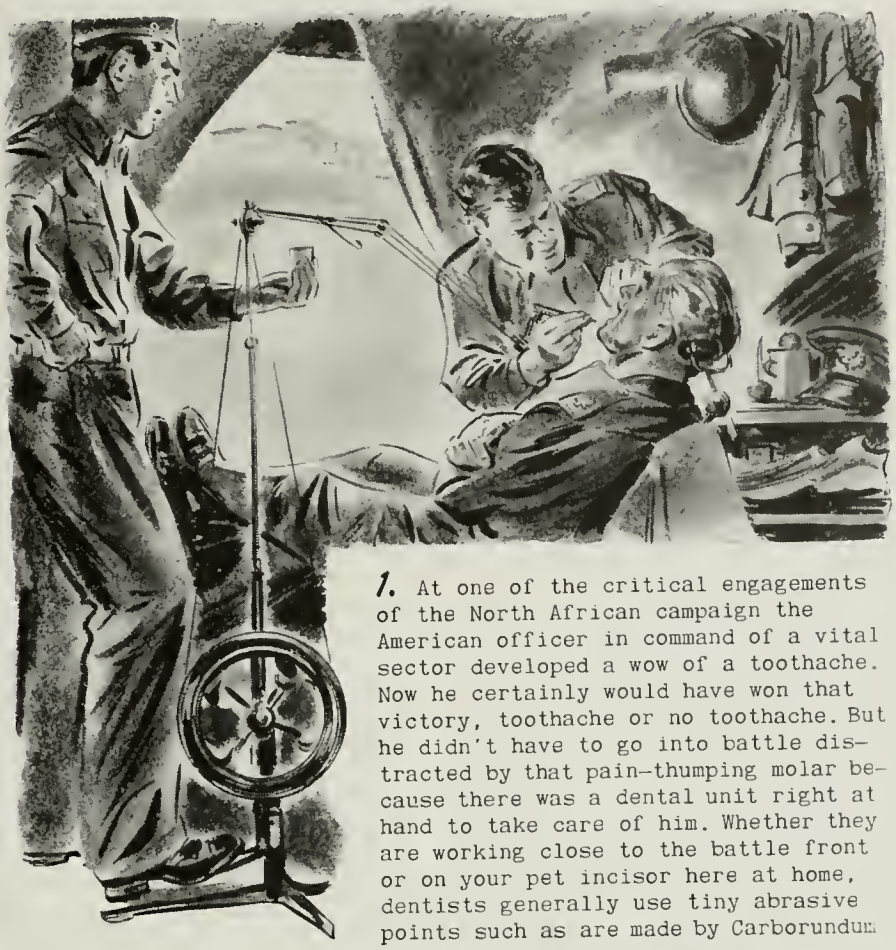
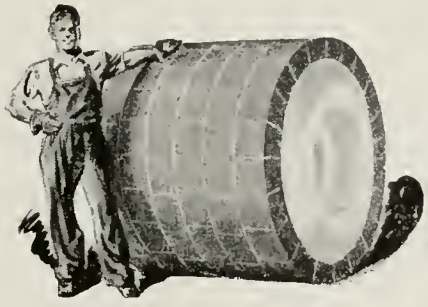
PLANTS IN 25 CITIES OFFICES EVERYWHERE

An African Victory that might have hung by a tooth!



1. At one of the critical engagements of the North African campaign the American officer in command of a vital sector developed a wow of a toothache. Now he certainly would have won that victory, toothache or no toothache. But he didn't have to go into battle distracted by that pain-thumping molar because there was a dental unit right at hand to take care of him. Whether they are working close to the battle front or on your pet incisor here at home, dentists generally use tiny abrasive points such as are made by Carborundum.

2. The Carborundum Company manufactures abrasive wheels for every grinding job, from little dental points to mammoth five-foot stones that grind logs to pulp for paper making. And in between are wheels by Carborundum for all the production grinding operations that are doing so much to speed the war effort.



3 The complete abrasive and refractory service that Carborundum offers industry will be of help to you in your work in the field. When you are in industry feel free to call on us for assistance. The Carborundum Company, Niagara Falls, New York.

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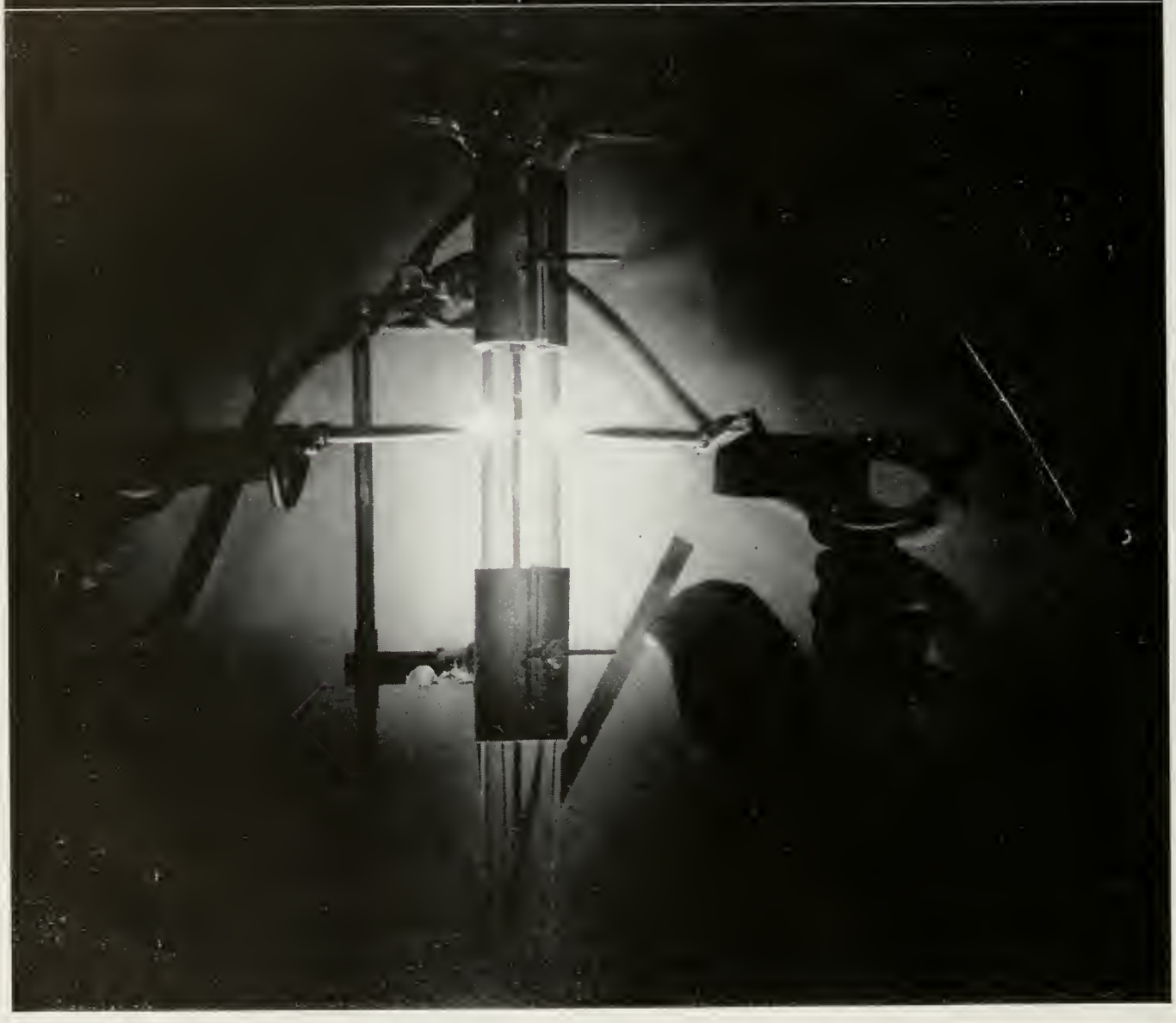
Sewing glass with a thread of fire...



FOR a long time industry has wanted a method by which two or a thousand pieces of glass pipe could be joined into a continuous piece. Corning has worked out a high-frequency electrical welding process that literally sews glass with fire.

It has these advantages: 1) It's faster than old methods. 2) It makes a smooth, transparent joint, just as strong as the pipe itself. 3) With the new portable welding equipment it may soon be possible to go into a food or chemical plant and install continuous glass piping right on the job.

Welded glass pipe isn't available now except to certain war plants. But it's another interesting development that points to a greater use of glass when some of the present restrictions on production are behind us. Others are a new type of glass so resistant to thermal shock that it can be heated cherry red and then sprayed with ice water without breaking; "ribbon glass" in sheets almost as thin as cellophane; and a new method by which accurate shapes of almost any size or description never before possible in glass can be quickly formed. Glass is going to play a major role in post-war. And Corning will be there with what it has learned during the war plus a background of nearly a century of glassmaking experience. You can count on it. Glass, the material with a sparkling future, will keep full pace with your own sparkling future as an engineer. Corning Glass Works, Corning, N. Y.

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Research in Glass

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THE TECHNOGRAPH

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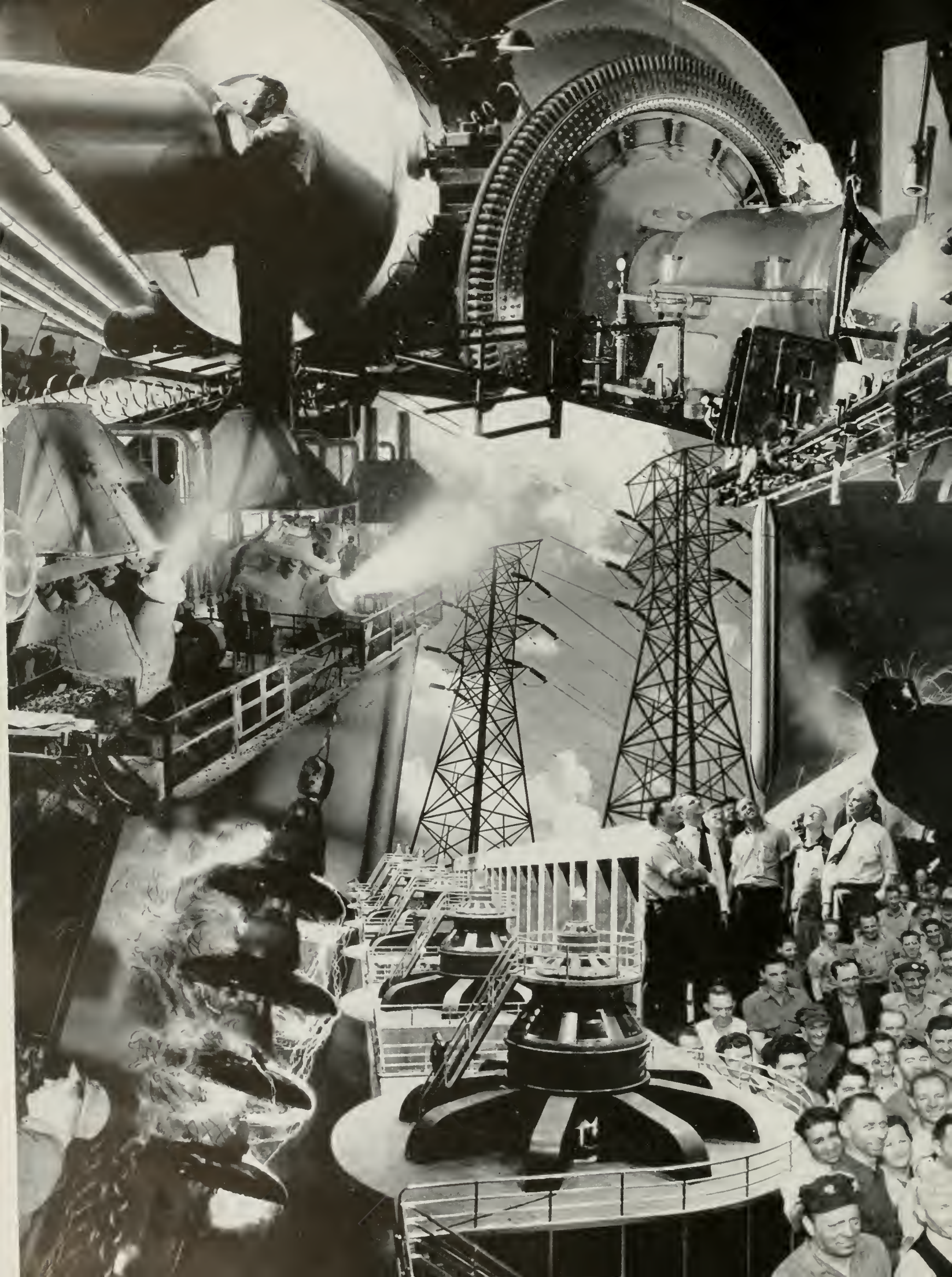
TO THE READER:

With this issue ends the 1943-44 publication schedule of the Illinois Technograph. The past year has witnessed one of the most difficult years for the "Tech." In spite of our high staff turnover (two business managers and three editors to the armed forces), we have received many compliments and helpful criticisms. Plans are now being formulated for a bigger and better magazine next year and we sincerely look forward to serving you at that time.

—Kacalieff



Abbott...
Power Plant

By H. F. HRUBECKY
Instructor M. E.

The prime purpose of this article is to acquaint the reader with some of the major causes which incipiated the construction and subsequent development of the Abbott Power Plant as well as the thermodynamic and design features that it possesses. The exterior view of this plant is shown on the cover.

The "old power plant" (this being the name given to the plant preceding the present one located immediately adjacent to the Mechanical Engineering Laboratory) was originally placed into operation as a two-boiler unit in 1902-03 and a final addition was incorporated in 1925-26 and enlarged several times in accordance with expansion of the University. In its final stage it was a 150 lb. operating plant containing 8 longitudinal drum stoker-fired boilers, with one 1000KW and two 500KW non-condensing units, generating at 2300V distribution potential with the exhaust steam being fed to the heating system.

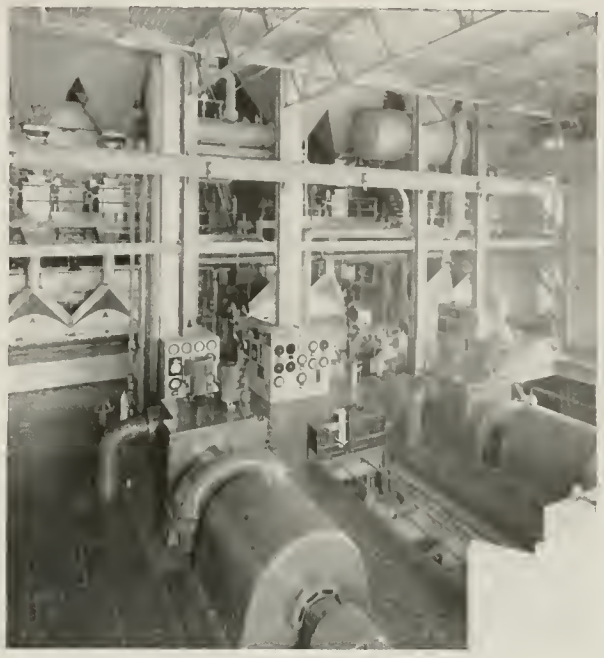
Electrical loads exceeding 2500KW had already taxed the then existing power supply to its utmost, the demand needs being in excess of the KW hours generated, consequently additional power had to be purchased from the Illinois-Iowa Power Company. The immediate question then confronting the University officials was whether to rebuild the existing plant or construct a new power plant taking cognizance of further campus expansion. The engineering issues kept in mind in arriving at the latter decision were the following:

A better standard of illumination was necessary for the existing buildings and also for the recently constructed buildings including the Illini Union, Gregory Hall, McKinley Hospital, Men's New Residence Halls, Geological Survey Laboratory, etc.

In addition, air-conditioning systems were planned for the Student Center and the new classroom building, as a consequence indications showed that the electrical requirements would reach a subsequent peak of 3400KW in the fiscal year 1940-41 far in excess of the available supply.

Finally, heating system requirements for the next ten-year period under standard design conditions of this locality indicated an increase to 200,000 pounds of steam per hour, an increase of over 50,000 pounds per hour for that period.

The abandonment of the alternate plan, that is, the rebuilding of the then existing plant, was due to the fact that it hindered any further expansion or improvement of the University's future projects. As an illustration, the former plant was located at the northeast extremity of the campus while all future projected growth was toward the south and west, disectionally opposite to the plants location which would have necessitated longer and additional steam mains. Nevertheless, space would have been available in the old boiler room by removal of six existing boilers lacking in heat recovery equipment and substituting therein the three 80,000 pound per hour steam generators required. Also by certain arrangement in the turbine room it would have been possible to install two 3000KW turbines. In that event thermodynamic, as well as mechanical alterations, would have to be made; steam pressure to 400 lbs. and temperature as high as possible to control exhaust conditions



Interior View Abbott Power Plant

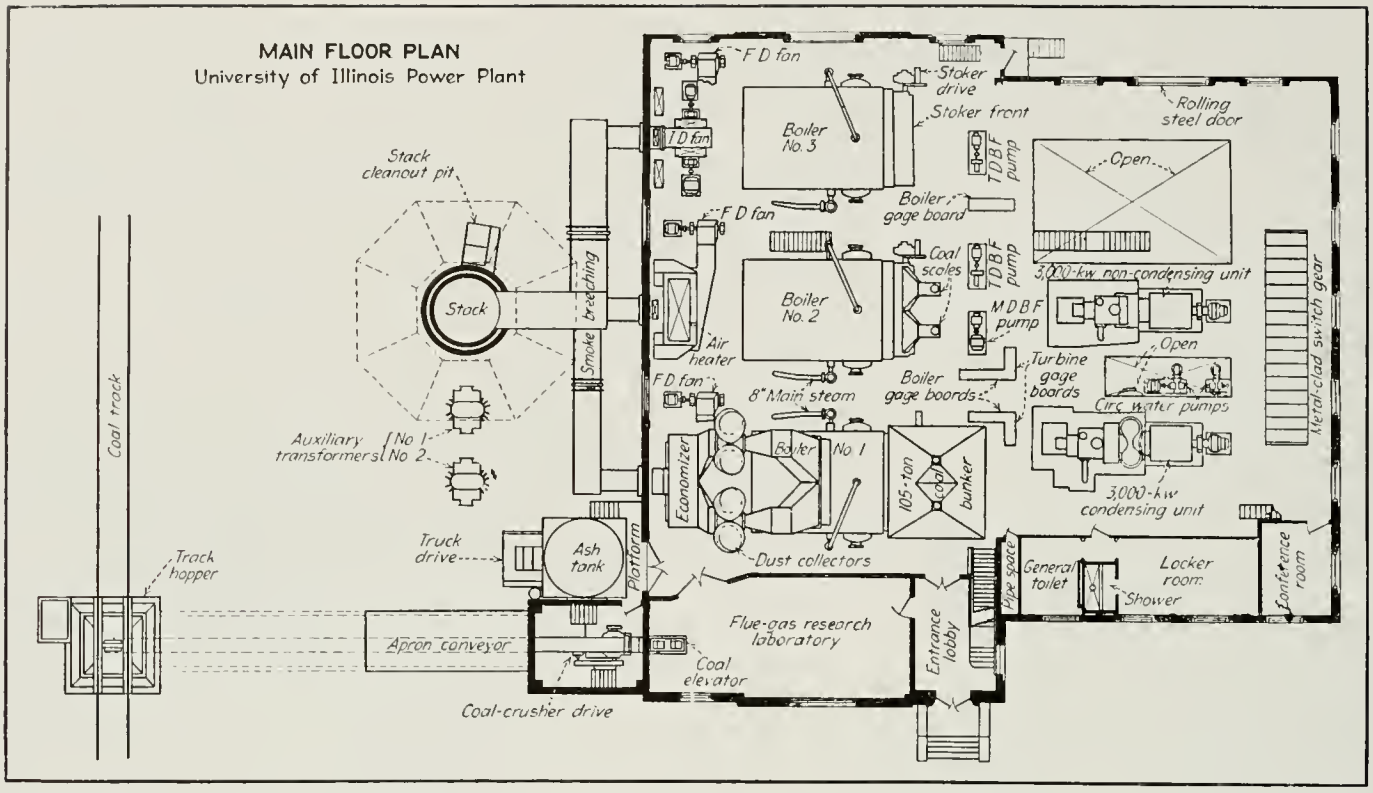
to a maximum of 400°F. In addition temperature and pressure reading equipment would be necessary to connect the new boilers and the generating equipment. Let alone mechanical difficulties, alterations in the structural steel supports, building walls, and floors would have to be made and all in progressive steps while the plant was in operation. Thus, are seen the overwhelming obstacles which confronted the adoption of this program.

Construction of the new plant began in January of 1940 and was totally completed in February of 1941. The plant was put into actual operation on September 23, 1940, and a short while later the contract with the I.I.P.C. was cancelled. The new plant operated in parallel with the former plant in the interval from September, 1940, to February, 1941. In direct contrast to previous practice, the U. of I. power plant began selling instead of buying power to the I.I.P.C., an amount reaching as high as 324,000KW hours in 1941-42.

For the year 1942-43 the plant generated a total of 12,911,800KW hours, as compared to 7,016,000KW hours for the final year (39-40) of operation of the former plant; for the same year period the U. of I. consumed 8,757,000-KW hours, thus necessitating the purchase of 1,741,000 additional KW hours.

The plant itself is located strategically with respect to the future expansion area as well as with the source of fuel, located on a siding connected with the Illinois Central Railroad System with coal storage facilities immediately adjacent to the plant. Steam service to the University buildings is effected by means of an 8'3" high by 7'6" wide concrete steam distribution tunnel, a photo of which is shown in an accompanying figure, containing two 12" exhaust steam lines, one 8" high pressure main for makeup and utility service, one 6" high pressure main for 150 to 25 lb. process steam, two 4" return mains and one 2½" compressed air line.

Temperatures in the tunnel attain values of 90-100°F., (thus affording an excellent substitute recluse for annual Florida enthusiasts). A maximum steam pressure of 70 lbs. is expected at 200,000 lbs. per hour flow. The high temperatures result in an expansion of 110" in the 4,000' run, the effects of this expansion being modified by double off-set expansion loops at approximately 270' centers. No expansion

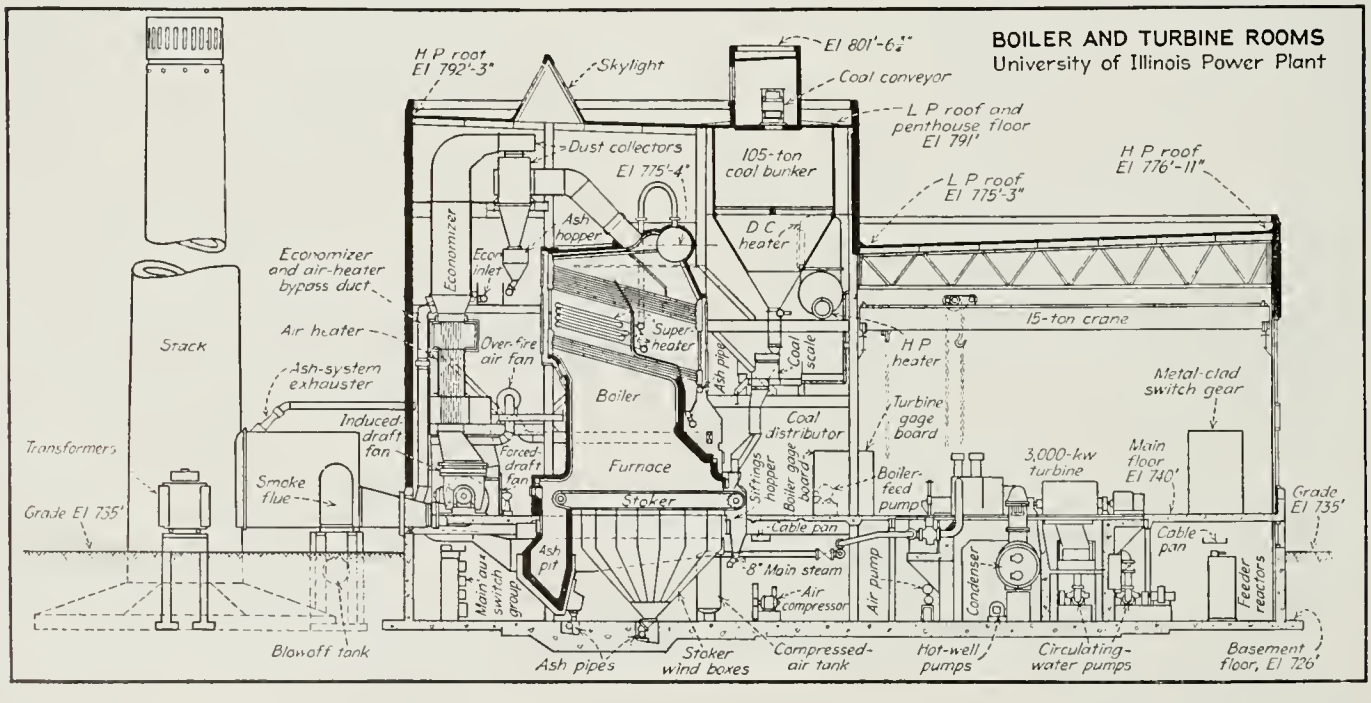


loops are used at the corners, the pipes being allowed to slide on flat plate supports. Provision is made for removal of drainage and storm water at the expansion loop vault while electrical power is distributed by cables run in a tile conduit about six feet from the pipe tunnel, with man holes at suitable distances.

A highly interesting and ingenious phase of the plant is its coal handling system. Manufactured by the Jeffrey Mfg. Co., it is designed to handle 75 tons per hour. The coal is fed from side or bottom dump cars into a 12′x14′ track hopper. At this point a reciprocating feeder supplies an apron conveyor, where, if necessary, the coal may be crushed and then sent by means of a bucket elevator and two longitudinal scraper conveyors to overhead double-hopper, Gunite lined rectangular coal bins, each having a capacity of 150 tons. Ash and dust are collected and removed from the ash pit stoker wind boxes, sifting and dust collectors, hoppers and the stack base by means of an ash handling system with a capacity of 15 tons per hour through an 8″ ash conveyor pipe with a steam consumption of 2700 lbs. per hour.

For the year 1942-43 the plant consumed 38,000 tons of coal with a corresponding boiler efficiency of 80 per cent, as compared to consumption of 43,000 tons for the year 1928-29 and a resultant boiler efficiency of 63 per cent. Thus can be seen the overall increase in efficiency of the power plant due to the modernized combustion system.

When consideration is given to the total heat, allocation,

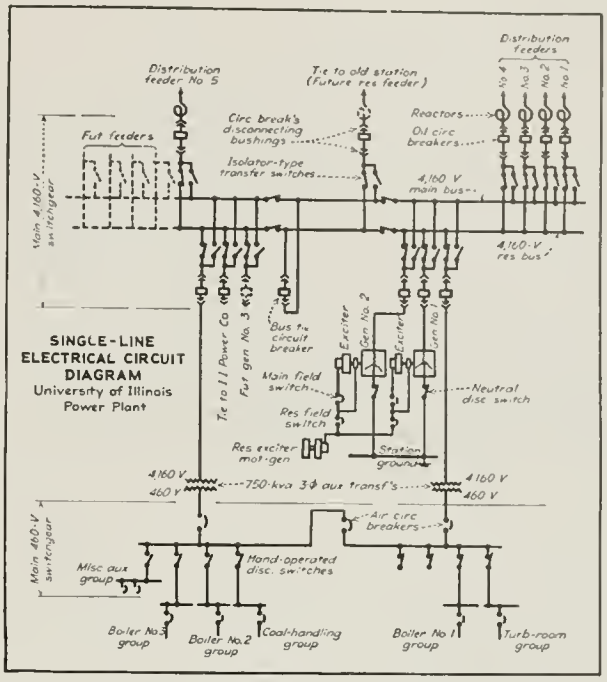


it is seen that the steam charged to power is nominal (13 per cent of the total). Correspondingly it follows that the main emphasis is placed on the heating system (87 per cent of the total); the obvious advantage being the centralized source of heat, resulting in prodigious saving from the economic point of view, when one considers the expense involved in sustaining individual heating plants for University buildings. At present the plant utilizes two 3000KW General Electric turbines to supply power. Each operate at 3600RPM, throttle conditions of 300 pounds, 625 degrees, and the same current characteristics (.8 Power Factor, 4160 2400 volt, 3 phase, 60 cycle). However, one is an automatic extraction condensing turbine while the other is a non-condensing, chosen in a manner to provide flexibility in operation. The condensing unit supplies heating steam through a grid valve at extraction pressures ranging from 10-70 lb. gauge with exhaust to a 2500 sq. ft. two-pass Allis-Chalmers surface condenser having 780-7/8", 18 BWG, 14' long copper tubes with a capacity of 30,000 lbs. of steam per hour; cooling water being provided at a rate of 4500 gallons per minute at 90°F. In the summer months the above will operate condensing with two-point extraction for feed water heating while the back pressure unit ex-

Steam Distribution Tunnel

hausts to the heating system at pressures up to 70 lbs. and has one uncontrolled extraction point for feed water heating (note Flow Diagram). Since no cooling water facilities are available in the plant itself a forced draft, wood filled, cooling tower with a capacity of 4708GPM, when operating with a 100°F. inlet water, 90°F. outlet water, and 78°F. wet bulb air temperature, is used.

A pressure- and temperature-reducing station is used to provide makeup steam when the turbine exhaust is inadequate. All campus condensate returns are collected in a deaerating heater floating on the heating supply line, and their temperature is further raised to 300°F. in a high-pressure heater previous to entering the economizer. The plan view of the plant shows that steam generation is provided by three Springfield cross drum, straight tube boilers, each having a heating surface of 6600 sq. ft. and a continu-



ous capacity of 80,000 lb. per hr. when burning central or eastern Illinois screenings of 10,000 BTU as fired heating value, the firing being done by three Babcock-Wilcox chain grate stokers. The use of stoker fired fuel in lieu of pulverized fuel is appropriate because of the proximity of the campus, the prevailing winds of this locality, range of load, lower maintenance, and usability of stoker cinders for road grading.

The boilers have a maximum steam working pressure of 375 lbs. per sq. in., a total temperature of 700°F., and an efficiency of 84 per cent, at a flow rate of 60,000 lbs. per hr. An important operating advantage of the new plant has been its high boiler efficiency, ranging in the neighborhood of 80 per cent as compared to the "old plant" which operated with an average boiler efficiency of about 65 per cent. In addition, the boiler furnaces are completely water cooled with a heat release of 30,000 BTU per cu. ft. per hr. at rated capacity. Buell type centrifugal collectors, located between the boiler and economizer, remove practically all the residue while the heat recovery equipment—consisting of economizers (each 2180 sq. ft.) and tubular air heaters (each 4600 sq. ft.)—are employed to reduce the final exit gas temperature to 375°F. at rated capacity.

An accompanying illustration presents electrical circuit system now in use—a 4160 volt, 3 phase, wye connected 4 wire system. The campus is divided into a number of

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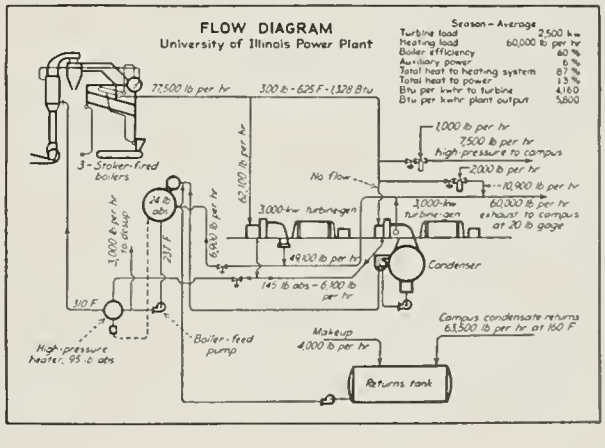

FLOW DIAGRAM
University of Illinois Power Plant
Season – Average
Turbine load 2,500 kw
Heating load 60,000 lb per hr
Boiler efficiency 80 %
Auxiliary power 6 %
Total heat to heating system 87 %
Total heat to power 13 %
Btu per kwhr to turbine 4,160
Btu per kwhr plant output 5,800
77,500 lb per hr
300 lb - 625 F - 1328 Btu
3 - Stoker-fired boilers
1000 lb per hr
7500 lb per hr high pressure to campus
2000 lb per hr
10,900 lb per hr
No flow
3000-kw turbine-gen
3000-kw turbine-gen
60,000 lb per hr exhaust to campus at 20 lb gage
Condenser
145 lb abs - 6,100 lb per hr
49,100 lb per hr
Campus condensate returns 63,500 lb per hr at 160 F
Boiler-feed pump
Makeup 4,000 lb per hr
High-pressure heater, 95 lb abs
Returns tank

At Illinois . . .

BACKWATER RESEARCH

By WM. D. MITCHELL and EDGAR G. BARRON
Associate Hydraulic Engineers U. S. Geological Survey

Kipling has said in his SUSSEX, "God gave all men all earth to love." Had he looked at the matter from the viewpoint of the technologist, he might have said that "He gave us all earth to use." The extent of this use is a matter of common knowledge; so common, in fact, that generally we fail to appreciate the circumstances. From the soil the farmer brings us food; from the rocks the miner gives us minerals; from the sea the sailor brings the products of other lands, and from this source may have come the beginning of life itself. From the air and the sunlight come contributions which are indispensable to the maintenance of life. Each of these factors, essential as it is to our existence, is impotent unless accompanied by one other. Without water, the farmer's domain becomes an unproductive desert; many of the veins of minerals never could have been deposited; the sea could not exist; the air and the sunlight would become insufferable.

On that portion of the earth with which most of us are best acquainted, water is now so plentifully provided that from a cursory examination there appears little cause for alarm. We are likely to forget how during the drought years of about a decade ago, herd upon herd of cattle was slaughtered because there was not water to keep them alive; how the air of even some of the eastern states was permeated with the soil which was blown from the parched fields of the western "dust bowl"; how the streams in certain industrial areas ran hot in summer because all the available water was used for cooling operations; how there was too little water to dilute the sewage and industrial wastes which were fed into numerous streams, so that the fish died for lack of oxygen and the stench was almost unbearable. We may not have known that in more recent years serious depletion of underground water supplies have occurred, aggravated by the tremendous pumping of ground water for use in air-conditioning operations.

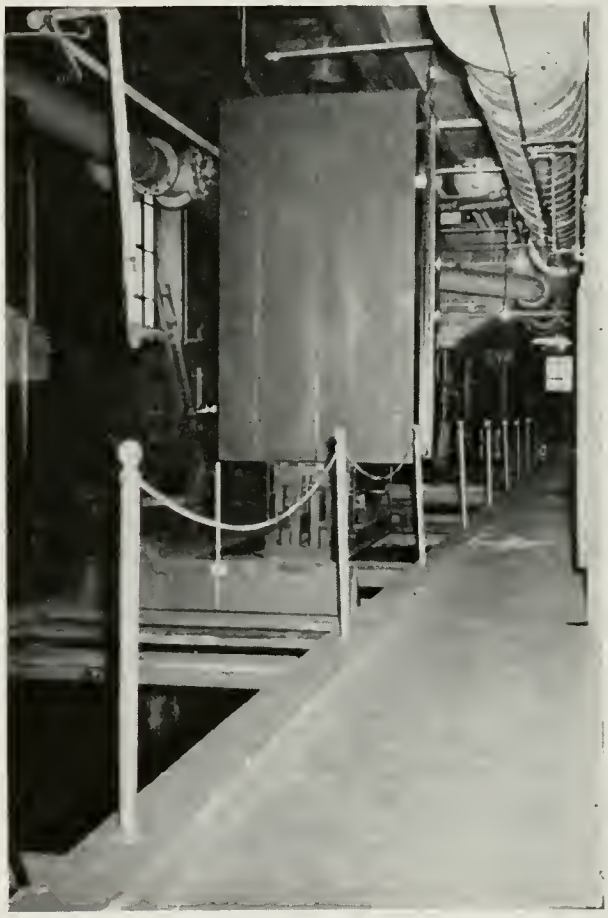
In contrast to these effects of drought are the more spectacular effects of floods. Still fresh in our minds, for example, are the results of the disastrous floods of May, 1943, for which it has been estimated that, in Illinois alone, damage to property and crops amounted to more than 31 million dollars. And a still more recent flood (April, 1944) in certain regions such as the Missouri River basin, has been even more severe than that of 1943.

Thus, it becomes apparent that water is a vital factor in our national economy, and indicates the desirability of maintaining an inventory of the flow of our rivers. This is accomplished by a continuing investigation commonly known as "stream-gaging". The major portion of this work is performed by the Water Resources Branch of the United States Geological Survey. The work was begun in 1888 in connection with special studies relating to irrigation. Measurements of the flow of streams and of the stage and contents of lakes and reservoirs have been made at about 9,120 gaging stations in the United States and also at many gaging stations in Alaska and Hawaii. The Geographical Survey and cooperating organizations now maintain about 4,850 gaging stations.

The base data collected at gaging stations consist of records of stage (elevation of the water surface), measurements of discharge, and general information used to supplant these data in determining the daily flow. The stage is observed at the time the discharge measurements are made. These two elements serve as ordinate and abscissa, respectively, for the development of a "rating curve" for the station. Records of stage are maintained continuously at each station, so that at times for which discharge measurements are not available, the daily discharge may be determined by use of the daily stage and the rating curve. In the elementary theory of stream-gaging, it is a basic principle that for a given site on any particular stream, and for a given stage, there is one, and only one, corresponding discharge. This appears to be a logical conclusion from an examination of the fundamental formula of hydraulics:

$$Q = Ac(RS)^{\frac{1}{2}}$$

in which Q is the discharge, A the cross-sectional area, c a coefficient dependent largely on the roughness of the channel, R the hydraulic radius, and S the slope of the water



Partial view of the 150 foot channel in Talbot Laboratory being used for the experiments in backwater flow.

surface. Assuming no change in the channel characteristics with respect to time, it will be seen that each of the above factors, with the possible exception of the slope, will vary only with the stage.

More advanced theory of stream-gaging recognizes the fact that in so far as the slope is concerned, it may vary independently of the stage. In a channel which, throughout its length, has a uniform cross-section, so long as the discharge is neither increasing nor decreasing, the slope of the water surface will be parallel to the slope of the channel bed, regardless of what the discharge may be. When the discharge is increasing, the slope becomes abnormally steep; when it is decreasing, it becomes abnormally flat. At certain gaging stations this variation in slope is negligible, but at certain others it becomes a factor of such magnitude that observations of, and corrections for, the slope and its variation become an essential part of the base data. This is usually accomplished by the installation of a second gage, as far as practical from the base gage, so that the stage may be observed at two points, and the slope computed by dividing the difference in stage by the distance between the gages.

When changing discharge the only cause of variation in slope, such treatment might prove to be adequate solution for even the most complicated gaging stations. Due sometimes to the requests of cooperating parties, and sometimes to the peculiarities of topography, it frequently becomes necessary to establish a gaging station a comparatively short distance from the confluence of two streams. Either of these streams may be tributary to the other, or there may be two of about equal importance whose confluence gives rise to a larger stream. In any case the effects appear to be the same; for the sake of simplicity, and for lack of a better term, the second stream will hereafter be referred to as the "modifying stream." The possibility now arises that during times of comparatively low discharge at the gaging station the modifying stream may be in flood. There then results an abnormally high stage at the point of confluence, the effects of which may be transmitted upstream to the gaging station to produce the condition known as "backwater".

This is a condition which is particularly common in Illinois, where approximately three-fourths of the boundaries of the state are composed of large rivers which in time of flood produce backwater effects extending untold distances into the interior. A few of the most outstanding examples will be cited: On the Illinois River, backwater from the Mississippi extends 80 miles upstream, past the gaging station at Meredosia to the dam at LaGrange. On the Kaskaskia River, backwater from the Mississippi frequently affects the gaging station at New Athens, some 41 miles above the mouth. On the Big Muddy River, backwater from the Mississippi has been known to affect not only the gaging station at Murphysboro, some 25 miles above the mouth, but also to extend above and affect the gaging station at Plumfield, which is some 50 miles above the mouth; in fact, at Murphysboro increasing backwater at times produces a reversal in the direction of discharge. Along the eastern border of the state may be cited Bonpas Creek, on which the station at Browns is at times affected by backwater from the Wabash River. Here in the spring of 1943 a discharge of 49 second-feet was measured under conditions of normal stage for 425 second-feet; this probably did not represent the greatest of the backwater effects. On the Saline River the gaging station at Junction is so greatly affected by backwater from the Ohio River that in the spring of 1940, during a time of rapidly rising stage of the Ohio River, an *upstream* discharge was measured which exceeded 2,000 second-feet. Obviously, the effects of these

(Continued on Page 12)

THE AUTHORS

MITCHELL and BARRON

Mr. Mitchell spent most of his boyhood on a farm in east-central Illinois. He was graduated from Oblong Township High School in 1920. Intermittently thereafter he was a student, a school teacher, a chainman with the Illinois Central Railroad and a Junior Engineer with the Illinois Division of Highways until he received his B.S.C.E. from Purdue in 1927. After a short and stormy summer as concrete inspector for the Alabama Power Company, he entered the U. S. Civil service as Junior Engineer in the valuation section of the Interstate Commerce Commission; six months later he requested and was given a transfer to the Water Resources Branch of the U. S. Geological Survey.

After three years in the Washington administrative office and the "middle Atlantic" district, he was transferred to the Indiapapolis district office to assist in field investigations in Michigan, Indiana and Kentucky. In 1939 he was transferred to the district office in Urbana, Illinois, where he has since been stationed. These assignments have given him opportunity to participate in the investigation of some of the country's most outstading floods, particularly that in the Ohio River basin in January-February, 1937, and that of central Illinois in May, 1943. Based on the data which became available after the flood of 1937, he made a study of the "Application of the Unit-Hydrograph Principle to Floods in Indiana" in partial fulfillment of the requirements for the degree of Civil Engineer which was given him at Purdue in June, 1938.

Mr. Barron was born and lived in North Little Rock, Arkansas, until about seven years of age. He attended school in Ithaca, New York, through the first six grades and in Bartlett, North Dakota, where he finished grade school. He was graduated from Lakota, North Dakota, high school in 1924 and received his B.S.C.E. from North Dakota State College at Fargo in 1928.

He was employed as junior engineer with the Illinois Division of Highways for a short time until entering the U. S. Civil Service as junior engineer in the Water Resources Branch of the U. S. Geological Survey in July, 1928. After about a year with the Water Resources Branch at Columbus, Ohio, he was transferred to Trenton, New Jersey, and later, in 1939, to Urbana, Illinois.

He has been engaged since October, 1943, in part-time graduate study and hydraulic research in the University of Illinois, under the direction of W. M. Lansford, Associate Professor of Theoretical and Applied Mechanics.

He is a member of: American Society of Civil Engineers,
Illinois Society of Engineers,
American Geophysical Union.

BACKWATER RESEARCH . . .

conditions upon the accuracy of records of daily discharge are such as to demand comprehensive methods of taking them into account.

So little has yet been done along these lines that a careful search of hydraulic literature fails to disclose even a satisfactory definition of backwater. One of the available few definitions appears in Water Supply Paper 888, U. S. G. S., where it is stated "Backwater is that condition of stream flow in which the velocity for steady flow gradually diminishes downstream and is manifested by the peculiar characteristic slope of the water surface in the direction of flow, which is always less than the surface slope that would occur if backwater was not present." It might also be added that, in general, the surface profile is a curve, rather than a straight line. This fact may at times invalidate the method of corrections based on the slope between two gages, since this method assumes a straight-line slope, when in reality the profile curvature may be so sharp as to represent appreciably different conditions.

During the past few years, the developments in fluid mechanics, accelerated by demands in the field of aeronautics, have given fresh impetus to hydraulic investigations. It is now commonly accepted that a theoretical approach to the problem of backwater should start from the formula which arises from a single differentiation of the Bernoulli equation:

$$dE_w/dx = d\,dx\,V_2/2g + dy\,dx + dh_o/dx$$

in which E_w is the total energy of the water, $V/2g$ is the velocity head, y is the static head, h_o is the head above the datum plane, and x is the distance along the channel. General solution of this equation frequently leads to insufferable complexities; however, it may be adapted to computation uses in several ways, including methods outlined by Rouse[1], by Woodward and Posey[2], and by Mononbe[3].

Of these methods, the first makes use of step-method, or computation of differential values, whereas the other two resort to simplifying assumptions to permit integration of the equation. The second method assumes a rectangular channel, and results in a complicated integral for which computations have been published as "Bresse's Backwater Function."[4] The third method assumes that the variables in the differential equation are exponential functions of the depth, which permits integration for certain cases and the preparation of curves from which interpolations may be made for all other cases. By each of the three methods, backwater profiles may be computed.

While the theorists were developing these methods, the stream-gagers had not been idle. In accordance with such theory as was available, and based on accumulated stream gaging data, they developed methods, largely empirical, of corrections for the effects of backwater. Among the most promising of these methods is a "correction curve" in which drop in water surface elevation from the gage to the confluence with the modifying stream is plotted as abscissa and the ratio between actual discharge and normal discharge is plotted as ordinate. If the backwater profile were a straight line, it would appear that this correction curve might assume the form of a simple parabole. Since the backwater profile is not a straight line, it appears that the form of the curve is more complex.

In an attempt to eliminate, or at least to mitigate, the hiatus between theory and field practice, the authors have undertaken an experimental investigation in the long channel in Talbot Laboratory under the general direction of W. M. Lansford, Associate Professor of Theoretical and Applied Mechanics. The theorists have performed invaluable work in the development of methods of attack; in so far as they have found opportunity, they have checked their theory by laboratory investigations. Mononobe, for example, made numerous profile observations in the laboratory. However, the channel he used when compared to those found in stream-gaging operations, was extremely small. The effective length was 30 feet; the cross sectional area at no time exceeded 1.1 square feet; the maximum discharge was 0.625 second-foot.

The channel in Talbot Laboratory in which the present backwater investigations are being conducted furnishes an effective length of 135 feet, a width of 5 feet, and a usuable depth 4 feet. Discharges up to 42 second-feet are available. Discharges up to about 12 second-feet are furnished by four pumps delivering water to a 65-foot stand-pipe, the overflow from which returns to the pumps. In this way a constant head is maintained on the 12-inch pipe delivering water from the stand-pipe to the channel. Greater discharges are delivered through a 24-inch pipe dierctly from a synchronous motor driven centrifugal pump which has a rated capacity of 13,500 gallons per minute against a head of 35 ft. at 600 r. p. m.

Current-meter measurements are used to calibrate the discharge valves as well as fluid gages indicating the difference in pressure on the inside and outside of 90° elbows on both sides the 12-inch and 24-inch lines. Measurements of the flow in depths less than about 1.0 foot are made with a standard Price meter when the depths are greater than 1 ft.

Since most natural channels have a positive bed-slope in the downstream direction, a sloping bottom was built on the horizontal bottom of the channel. Most problems in surface profiles occur in channels of "mild" slope—that is channels so flat that flow is always at depths greater than critical. Calculations indicated that to have a "mild" slope with roughness that could be satisfactorily produced in the channel, a bed slope of 0.003 would be about as steep as could be used. A sloping bottom was constructed of 1-inch tongue and groove cedar, to a slope of .003. Experiments indicated that 2"x4" wire mesh on the bottom and sides of the channel would simulate a roughness of about $n = .02$. The actual value of n for the channel after installation of the wire mesh was found to be 0.019.

To eliminate surface disturbances in the channel due to the fact that the upstream end of the wooden bottom was about 16 inches above the original channel bottom, a streamlined approach section was constructed. The radius of curvature of the 6-foot approach section varies from 5 feet at the upstream end to 15 feet at the end tangent to the sloping channel bottom. Most of the rather violent disturbance caused by the high velocities from the discharge pipes is dissipated through a screen installed a few feet upstream from the approach section.

The surface profile is measured by ten point gages mounted over the center of the channel at 15-foot intervals. The most downstream of these gages is at the downstream end of the sloping section where a one-foot drop to the original bottom occurs. An additional gage to indicate the elevation of the backwater is located one foot downstream from en dof the sloping bottom.

Adjustment of water surface elevation at the downstream end of the channel is accomplished by a steel gate hinged on the floor of the channel and which can be raised and lowered by means of a chain-hoist.

(Continued on Page 20)

[1]Rouse, Hunter, Fluid mechanics for hydraulic engineers, p 296, eq. (216), 1938.

[2]Woodward, S. M., and Posey, C. J., Steady flow in open channels, p. 66, eq. (608), 1941.

[3]Monobe, Nagaho, Backwater and dropdown curves for uniform channels; Am. Soc. Civil Engs. Trans., vol. 103, pp. 950-989, eq. (18), 1938.

[4]Woodward, S. M., and Posey, C. J., Steady flow in open channels, table 601, 1941.

. . . a wartime problem in Engineering

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NAMES *in the* NEWS

By CHESTER D. MARQUIS, M.E. '45

WALLACE STORTON FRANK

Golconda, Illinois, has every right to be very proud of this one of her native sons, for he has well distinguished himself at this University.

Beginning with Phi Eta Sigma in his Freshman year,

Wally has been elected to all other honoraries available since. He is president of Tau Beta Pi, all engineering scholastic fraternity; secretary-treasurer of Omega Chi Epsilon, Chemical Engineering honorary; Master of Ceremonies of Alpha Chi Sigma, Chemical Social fraternity; undergraduate secretary of Phi Lambda Upsilon, Chemistry Honorary; and is a member of Sigma Tau, all-engineering honorary, Sigma Xi, research honorary; and Phi Kappa Phi, All-University honorary.

He has made Honors day the past three years, and was awarded the University scholarship key. Further, Wally is the Vice-President and Secretary of the local student branch of the American Institute of Chemical Engineers.

In his first two years, Wally distinguished himself also in the field of military activities. He was recipient of the Chicago Tribune Award for the sophomore cadet with a straight "A" average in all university courses and an "A" record in military. He received also the Scabbard and Blade award for being the best drilled sophomore cadet engineer at Illinois, and was, of course, the holder of the military excellence bar with stars. He is a member of Pershing Rifles, military society. In his second year, Wallace was granted the Thomas Arkle Clark award for the highest grades of a sophomore in Phi Eta Sigma.

Although Wally obviously hits the books once in a while, he has been able to find time for other activities. He is a member of the Wesley Methodist Foundation. Wally is interested in good music in general and played the clarinet in his high school band. He used to play basketball, but finds that lately being a fan takes about all the time he can spare. Stamp collecting and model planes have also taken a back seat lately.

At present Wally is a laboratory assistant in Applied Chemical Testing for the Commercial Analytical laboratory maintained by the University.

His immediate future is in the Navy's Radar training sometime in the next few weeks, but looking ahead, Wally plans to go into Chemical Engineering, production work or to earn a Master's degree. He comments that the Chemical Engineering Department is giving excellent practical training for work in industry.

BENJAMIN COPITO

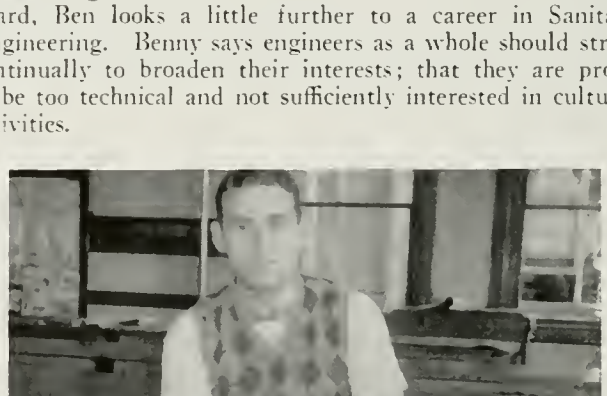
Ben comes from Flatbush and although he is a Dodger fan, he maintains a surprising tolerance for the less fortunate.

This man has really 'been around' in his University experience. His first year was at Brooklyn College, followed by a year at the College of the City of New York. For the past two years, Ben has been at the University of Illinois, and plans to graduate shortly in Civil Engineering with an average of 4.2.

As extra-curricular activities, Ben lists participation in the American Society of Civil Engineers, Sigma Tau, and dramatic productions. He played well the part of Achilles in "The Warrior's Husband" for the Illini Theater Guild several weeks ago.

He has been on Honors Day the two years he has been at the University and lists painting, both in water color and oils as his main hobby. Ben has been working lately for Professor Schrader of the Mechanical Engineering Department in the Railway Test Laboratory on wheel and brake shoe tests.

Although he has a 1-A classification with his local board, Ben looks a little further to a career in Sanitary Engineering. Benny says engineers as a whole should strive continually to broaden their interests; that they are prone to be too technical and not sufficiently interested in cultural activities.



BEN

GEORGE WILLIAM OBERLE

Playing bridge, bowling, and dancing are the chief recreations of this busy Electrical Engineer from Pekin. Bill confides further that he had time for French horn and violin playing and considerable debating in high school, although they have taken a back seat to E.E. lately. The

(Continued on Page 18)

High-Speed Photography . . .

Ever since men have been studying and analyzing high-speed mechanical motions, there has been great need for some means to photograph these motions in a period of time sufficiently short to effectively "freeze" the mechanical action.

Since, at the present time, the probability of encountering any mechanical speeds higher than 2,000 feet per second is very small, we may assume that if means are available to photograph an object moving at this speed with reasonable detail, the requirements of the high-speed analyst will be met. An object travelling 2,000 feet per second moves 0.024 in. per microsecond. For most purposes, an amount of motion of this order is tolerable in an object photographed at life-size or smaller, and will allow a reasonable analysis of the motion involved.

Taking pictures in millionths of a second could conceivably be accomplished by one of two general methods: first, by the use of a very high-speed mechanical shutter of special design; or, second, by the use of a slow shutter and a very short-duration flash of light. Since the design and construction of a mechanical shutter capable of such speeds would present a most difficult, costly, and complicated problem, the most likely means of solution then becomes the use of a short flash of light at high intensity.

The source of such a light, in order to be satisfactory, should possess the following qualifications:

(1). The duration of the flash of light should be short enough to be able to photographically "stop" any any mechanical motion which is liable to be encountered.

(2). The unit should be light in weight, compact, and easily portable.

(3). It should be adaptable to a large number of varied tripping techniques in order to facilitate synchronization with the motion being analyzed.

(4). It should be simple in operation.

General Electric's General Engineering laboratory has produced a sample of such a photolight unit. Illustrations of the unit—showing its exterior, interior, and its lamp—together with some high-speed photographs in which the unit was used as the source of illumination, appear on the next two pages.

The entire assembly of the unit is contained in a case 9 by 9 by 10 in. and weighs about 20 pounds. The only equipment which is not contained within this box is the actual pick-up portion of the synchronizing unit and the cable which connects it to the main case.

Three types of synchronizing methods are available. The first is a phototube pick-up unit which is so arranged that the lamp may be tripped either by cutting off a light beam falling on the cell or by turning on a light beam directed at the cell. The second method consists of the opening of normally closed contacts between two external terminals provided on the unit. The third method consists of the closure of normally open contacts between external terminals. The latter two methods are readily adaptable to a number of tripping devices, such as a commutator to synchronize the flash with a certain position of a rotating wheel.

The circuit of this photolight unit consists essentially of a capacitor which stores energy and a switching arrangement which releases this energy through the lamp. The lamp is of the high-pressure mercury-vapor type.

Either of the following basic methods can be used to flash the lamp: first, through a switch placed directly in the discharge circuit which completes a direct circuit between the capacitor and the lamp; or second, by the use of a thyratron acting as a switch. In the second method the switching circuit controls the grid of a thyratron, which in turn controls the current through the lamp. With this method, flashing control is obtained in a 2,000-volt circuit by the switching of a 35-volt low-current circuit.

The photolight unit as now assembled gives an illumination sufficient for photographing a 20 sq. ft. area of average subject matter, using standard negative materials and a camera equipped with F 4.5 lens. In the present equipment the lamp may be flashed approximately once every 5 seconds at about 95 per cent of its maximum intensity. However, it may be flashed approximately twice per second at a lower intensity. This lower intensity is ample for visual examination of a moving body, but it is not sufficient for photographic purposes.

The life of the lamp is not definitely known. However, it is a matter of record that one lamp was flashed 330,000 times in the laboratory at the rate of one flash every 5 seconds, and at the end of this test was still operative. Further tests are now being made to determine the useful life of the lamp in this service. It is also worthy of note that the run mentioned was completed with the use of a single thyratron.

The rate of discharge of power through the lamp is in the order of 1,000,000 watts, but due to the short duration of the flash the high momentary current does not cause serious heating.

Measurements of the duration of the flash have been made by two widely varying types of measurements, and a close agreement was found which averaged about three microseconds for the effective peak. This duration is so short as to be equivalent to only 0.072-inch travel of an object having a speed of 2,000 feet per second.

The photolight was designed to provide a high intensity of illumination on a relatively small area for scientific study, and is therefore not generally usable where photographs are to be made of large fields of view.

(Illustrations courtesy General Electric)

TECHNOCRACKS . . .

Noah's ark had finally come to rest on the mountain top, and the animals were herded off, two by two. Noah remained behind, and as he stood surveying the scene, he heard a terrible sobbing. He went back to the ark and searched until he found two snakes in the corner, weeping bitterly.

"Why, what's the matter?" asked Noah.

"Alas," wailed one snake, "you told us to go and multiply, and we're only adders."

* * *

Two small negro boys were sitting on the curb. One turned to the other and said, "Ah's five, how old is yo?"

"Ah doan know. Ah guess ah's five, too."

"Does you dream of wimmen?"

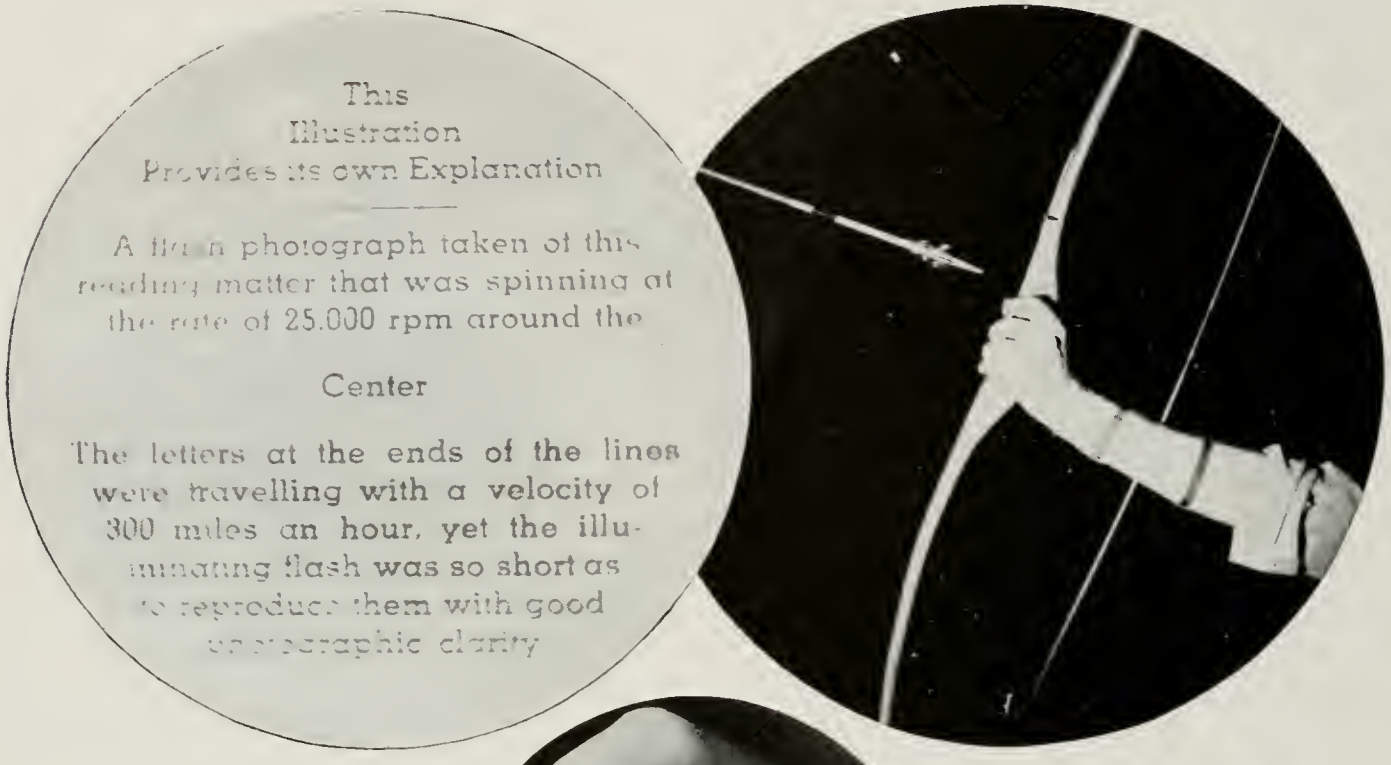
"Nope."

"Yo's only foh."

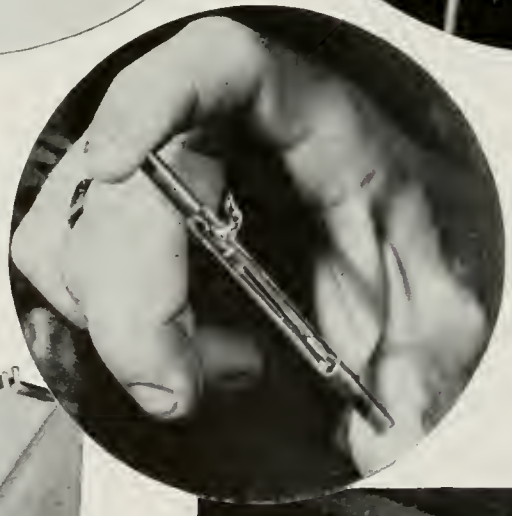
HIGH-SPEED PHOTOGRAPHS . . .

And Electronic Photolight with which they were made

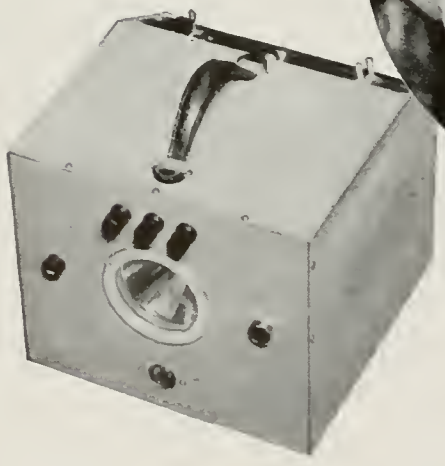
Article on preceding page


This
Illustration
Provides its own Explanation
A flash photograph taken of this
reading matter that was spinning at
the rate of 25,000 rpm around the
Center
The letters at the ends of the lines
were travelling with a velocity of
300 miles an hour, yet the illu-
minating flash was so short as
to reproduce them with good
photographic clarity

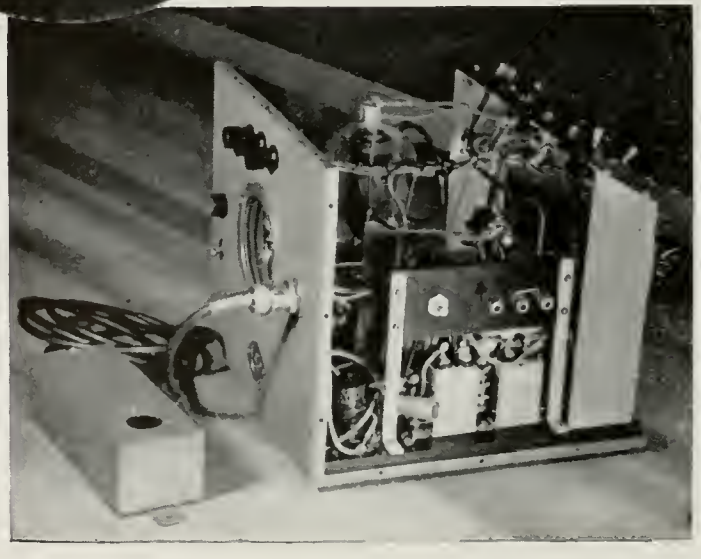
Arrow in flight from bow. Note the curve of the bow string



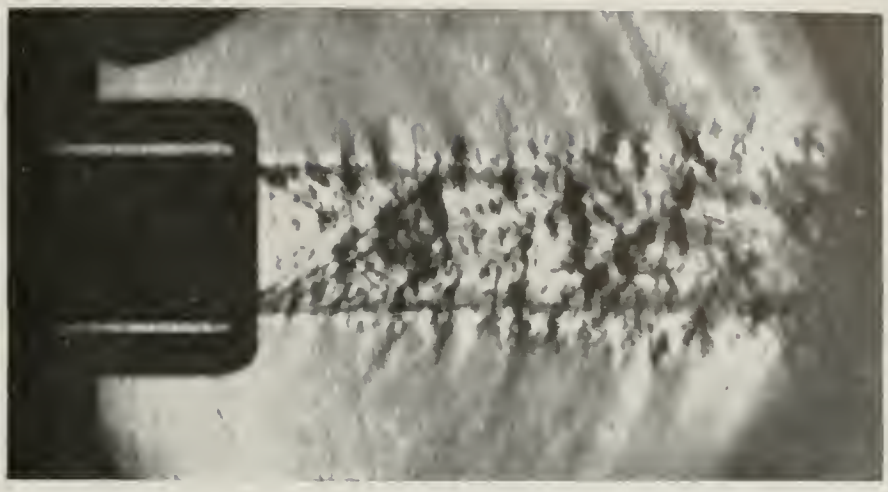
The high-pressure mercury-vapor lamp that emits the ultra-short brilliant flashes is here shown removed from the cabinet of the Photolight



Exterior of the electronic Photolight. For manual control of the flashes, the unit needs to be connected only to a convenient 115-volt 60-cycle source



Interior of the Photolight, together with separate phototube auxiliary that is used when the flash is to be automatically "tripped" by a beam of light

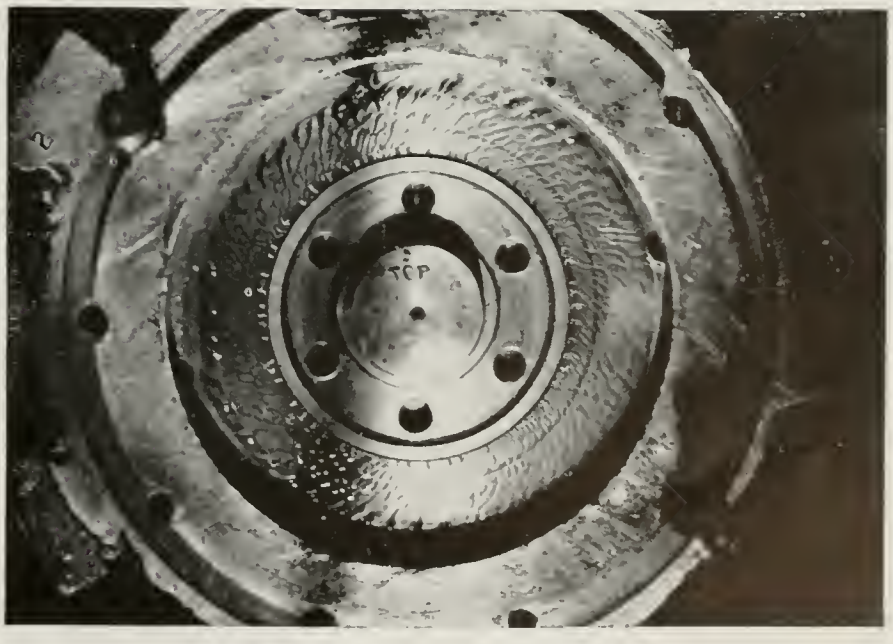


Air stream from a 2-inch orifice at a velocity of approximately 1600 ft per sec. The lines within the air stream are shock lines, and the lines at the end of the stream and at each side of it are apparently shock lines in the adjacent atmosphere

Whorl around the tip of a fan blade rotating at 1800 rpm. The whorl is indicated by heated air supplied by a Bunsen burner that was placed outside the field of the photograph

Water from a suddenly opened mixer-type kitchen faucet. The indicated progression was obtained by flashing (with different timing) three separate opening operations of the faucet. A noteworthy characteristic of the shape of the water is the ball-like end. The additional "tear-drop" end in the third picture may have been due to an air bubble which had lodged in the faucet just back of the nozzle

Three-inch-diameter wheel rotating at 21,000 rpm. The flash was so quick that the details of the wheel, the word "TOP" stamped on its shaft, and the ripple pattern of oil being thrown outward are all shown without blur



NAMES IN THE NEWS . . .

last time he figured his all-U average, it stood somewhere in the neighborhood of 3.98, which is plenty good in his course. Bill finds himself one third of the June graduating class in his department.

This man is secretary of his fraternity, the Triangle House, and an active member of the campus branch of the American Institute of Electrical Engineers. Honors day claimed him in his first two years at the University. The evening of commencement, Bill is taking off for Camden, New Jersey, to start work June seventh in the Communications and Industrial Engineering Department of the Radio Corporation of America laboratories.

As to the woman situation on the campus, Bill says that at present he is "playing the field." When asked of his thoughts lately, Bill admitted: "I am looking forward with great interest and longing to the first Illini Homecoming after the War to see all the old gang back and have one swell time. I'll be here if I have to quit my job."

WILLIAM ERNEST STROUD

Bill comes to us from Rochelle, Illinois, after two years in General Engineering at Bradley Polytechnical in Peoria, where he was head manager of the baseball team. At the U. of I., Bill is in Mechanical Engineering and is to graduate this semester. He plans to begin work in the middle of June for the Corning Glass Company in Corning, New York, as a mechanical research engineer in design and research on glass manufacturing machinery.

Work as a laboratory assistant with Professor Mohn in the M. E. Laboratory on drawings and specifications for proposed equipment takes up a lot of Bill's time. He is a member of Pi Tau Sigma, Mechanical Engineering honor fraternity, the University Y. M. C. A., is president for this semester of the Student Branch of the American Society of Mechanical Engineers, and is a member of Lambda Chi Alpha, social fraternity, of which he has been house manager for the past two years. Bill is very much interested

BILL STROUD

in inter-fraternity athletics, particularly baseball and basketball, and claims as avocation reading, model airplanes and his being a loyal Cub fan. He mentions that he is very much interested in "a little girl back home."

Bill says that he has enjoyed very much his experience at the U. of I. and hopes he can live up to the standars set by former graduates. His only comment on his curriculum is that he is very glad to see the development of a good department of aeronautical engineering on the way.

JACK WILKINSON

In the photo above is none other than Jack Wilkinson, diligent former editor of the TECHNOGRAPH who was just called to the armed forces. The call of the bugle was so sudden that we didn't get a chance to gather a few facts about his life. We leave the reader only with Jack's picture.

MORE TECHNOCRACKS . . .

I had a bunny,
His name was Jim.
Got sixteen now,
Her were no him.

* * *

Judge (to thug): "So they caught you with this bundle of silverware. Whom did you plunder?"

Thug: "Two fraternity houses, your honor."

Judge (to sergeant): "Call up the downtown hotels and distribute this stuff."

* * *

They are all talking about the couple who just had twins.

"And to think," said one lady, "twins happen only once in 50,199 times."

"My," said another, "When does she have time for her housework?"

* * *

An insurance salesman tells about a valuable wardrobe that his firm insured for a client during a European trip. Upon reaching London she wired: "Gown lifted in London." After due deliberation he sent this reply: "What do you think our policy covers?"

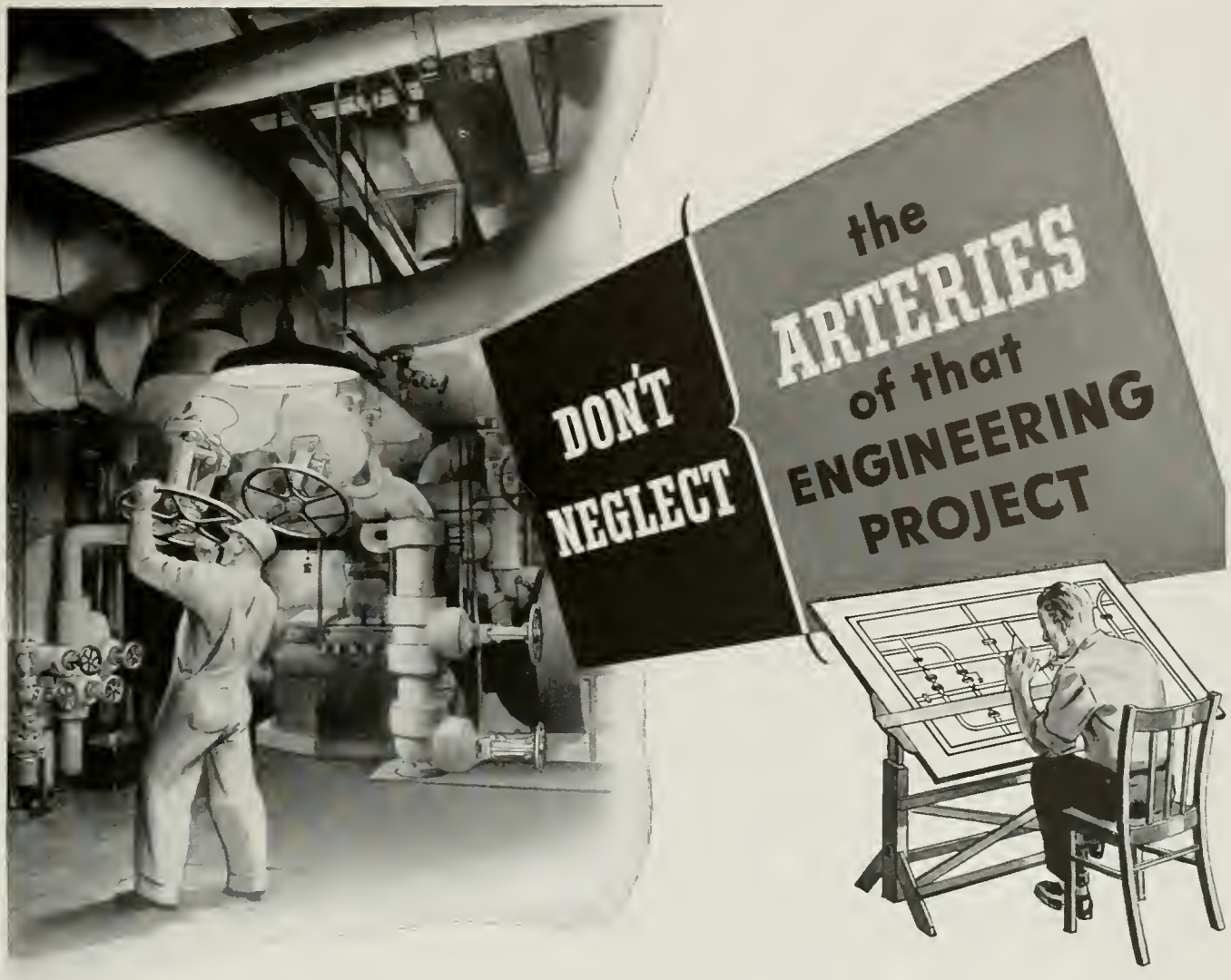
* * *

She was only a miner's daughter, but oh! what natural resources.

* * *

Mother (on entering the room unepectedly): "Well I never——"

Daughter: "Oh, mother, you must have!"



PIPING is an important part of almost every engineering project. When you indicate a pipe line on a drawing, think of it in terms of the pipe, the valves, the fittings, the unions, the traps that it will ultimately be translated into. Think of the metals of which it will be made—brass, iron or steel. Consider how it should be assembled—bolted, screwed or welded.

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PLUMBING • HEATING • PUMPS

BACKWATER RESEARCH . . .

(Continued from Page 12)

The procedure followed for each surface curve to be determined is as follows:

(1) Adjust the valve on the discharge line to the discharge desired and check by reading the differential gage.

(2) Adjust the backwater gate to produce a constant depth through the entire length of the channel. This represents the condition of flow in a uniform channel without backwater.

(3) Raise the backwater gate until the most upstream gage (No. 3) reading is increased slightly, say 0.01 foot.

(4) Read all gages farefully.

(5) Readjust the backwater gate until gages 6, 7, 8 and 9 indicate the same depth as gages 0, 1, 2 and 3 did previously. (This allows 45 feet lap in the sections of the curve.

(6) Read all gages for this condition.

Continue this procedure until the backwater is so great as to allow only about 0.01 foot of slope in the water surface in the 135-feet of channel.

While this investigation still is on a much smaller scale than actually encountered in stream-gaging, it at least is a long step in the desired direction. Furthermore, the theorists, as yet, have had no occasion to attempt to adapt their studies to the problem of correcting a normal stage-discharge rating for backwater conditions—a problem which will be given most careful attention in the present investigations.

The proposed solutions to backwater, as advanced by the stream gagers, are as yet on uncertain ground. Although they appear to offer a basis for satisfactory results, there are numerous instances of discordant data. It may be, as Osborne Reynolds once wrote, "This accidental fitness of the theory to explain certain phenomena while entirely failing to explain others, affords strong presumption that there are some fundamental principles of fluid motion of which due account has not been taken in the theory." On the other hand, it may be that such discordance is the result of factors of topography, or of changing discharge or of other factors which the stream gager is unable to observe, or being able to observe, is unable to control or evaluate. In the present laboratory study it is believed such disturbing factors can at least be reduced to insignificance, and thus be made to indicate whether the stream gager's methods are lacking in theory or lacking only in refinement.

Another of those two lunatics gags.

"What have I got here," said one, with his hands cupped.

"A squadron of B-17's?" answered the second.

The first peeked carefully into his hands. "Nope."

"Nope."

"The Philadelphia Symphony Orchestra?"

The other looked into his hands again and said shyly, "Who's conducting?"

A recent issue of the Alumni News carried a photograph of the new Abbott Power Plant. The caption said, "The new power plant is as efficient as electrical engineering skill can make it." The editor is lucky that few mechanical engineers read his paper. Or does he think we can't read?

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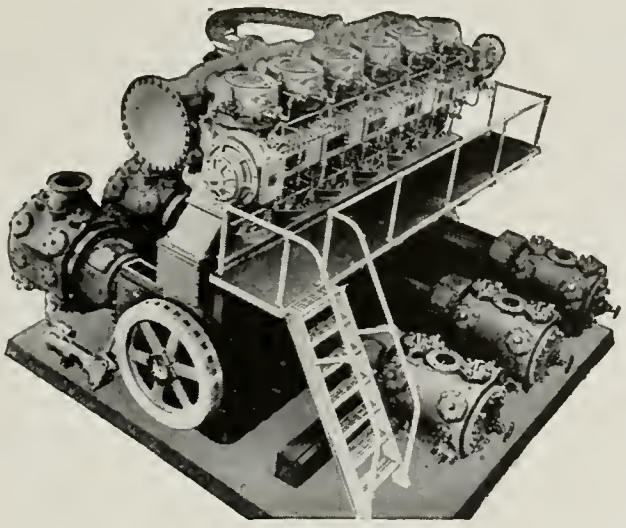

CLARK 6 Cyl. 3000 B. H. P.
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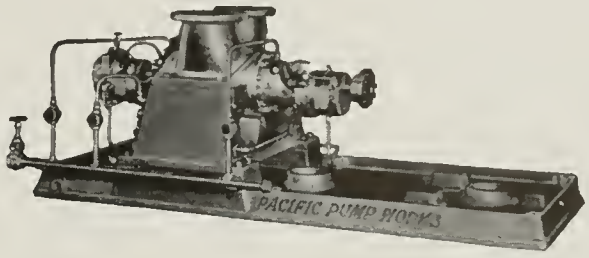

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By H. W. NIEMAN, C. E. '46

NEW OFFICERS ANNOUNCED

Sigma Tau

Adrian Wells.....*President*
Wallace Frank.....*Vice President*
John Asherman.....*Secretary*
Raymond Skaggs.....*Treasurer*

Tau Beta Pi

Richard Conklin.....*President*
Ralph Porter.....*Vice President*
Frederick Liederback.....*Treasurer*
Harold Eckhoff.....*Corresponding Secretary*
Wendell Wilson.....*Secretary*

Chi Epsilon

Wendell Wilson.....*President*
Harold Eckhoff.....*Vice President*
Paul Monohon.....*Treasurer*
Walter Crum.....*Secretary*

TAU BETA PI

Tau Beta Pi held its spring initiation meeting May 19 at the Y.M.C.A. Prof. H. A. Babbitt acted as toastmaster and Prof. A. W. Aron, head of the German Department, gave the evening's address.

Those initiated were: Raymond Albert, Richard Ball, Royce Beckett, Robert Gleason, John Harder, Frederick Liederback, and Ralph Porter, M.E.'s; Harold Eckhoff, Lloyd Jones, Wendell Wilson, C.E.'s; John Giachetto, Chem.E.; Warren Pesci, Arch.E.

JOINT HONORARY MEETING

Because of the depleted number of engineering students, three honoraries, Sigma Tau, Pi Tau Sigma, and Chi Epsilon, banded together in a joint initiation dinner meeting at the Urbana-Lincoln Hotel, April 30.

New initiates were Lowell Ackmann, Raymond Albert, John Asherman, Benjamin Homer, Ralph Kelly, Robert La Plante, Richard Medal, Herbert Newmark, Joseph Peckloff, Warren Pesci, Ralph Porter, Raymond Skaggs, Marion Walls, and Jack Wilkinson.

The Sigma Tau award for scholastic achievement was presented to John Ries Leek, C.E., by Dean Jordon. Toastmaster for the evening was Prof. A. R. "Buck" Knight, E.E. The address of the evening was "Armor Piercing Projectiles," by Prof. H. L. Walker, head of the Mining and Metallurgical Department.

A. I. CHEM. E.

The annual A. I. Chem. E. banquet was held May 17. Dr. Moller gave a talk on copper ores. Bob Hammer acted as toastmaster.

An election of new officers for the summer term was held. Those elected are: Bill Severns, president; John Giachetto, vice president and secretary; Wally Frank, treasurer; and Dr. Clay Lewis, faculty adviser.

A. S. C. E.

At the recent Civil Engineering Convocation, the annual presentation of the Ira O. Baker awards for outstanding students were made by H. H. Jordon, associate Dean of the College of Engineering. First prize of $40 and an engraved certificate was tendered to Sheldon Leavitt, now on active as an Ensign in the Navy, while the second place award of $20 and an engraved certificate went to Harold Clinton, a graduate-student on the campus.

The Convocation was opened by Prof. W. C. Huntington, head of the Department of Civil Engineering. Prof. Oliver explained the nature of the meeting and was followed by Dean Enger who gave a short discourse on the life of Ira O. Baker. Dean Enger at one time had been a student under Prof. Baker and told how at that time most of the instruction was oral, there being very few texts in existence on engineering subjects. Prof. Baker published some of the first engineering texts in blue print form.

A. S. M. E.

At the recent district meeting of the Central Illinois Society of A.S.M.E., Professor Trigger was featured as speaker. His topic was "Hardening Cycles of High Speed Steels." At present he is engaged in research on chilled high speed steels at temperatures as low as 120° F below zero.

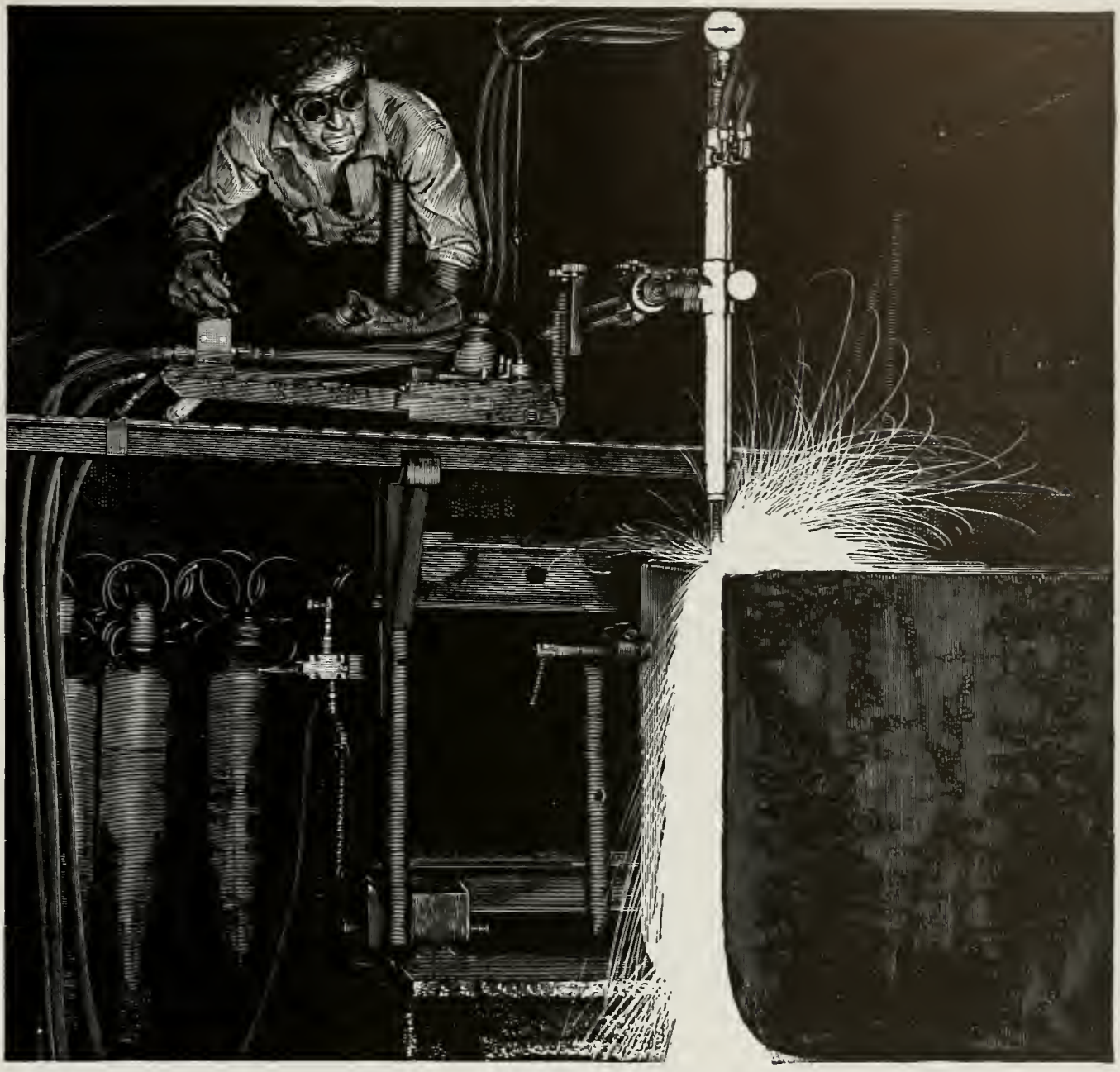
POSTWAR TELEVISION STUDIOS

A working model of television studios designed for the postwar broadcasting of regular commercial network programs with large studio audiences was recently exhibited by engineers of The Austin Company in New York. The model was "unveiled" at a press luncheon where Dr. Walter R. G. Baker, vice president of General Electric Company and other G-E officials discussed "Television Postwar" and announced the company's plans for the new industry. Austin engineers have developed a basic new building design for the studios, with a turntable stage and unique layout which make it possible to accommodate rapid changes of scene and audience without duplication of costly television equipment.

Separate audience seating areas, each accommodating several hundred people, are provided on either side of a single broadcasting control room and overlook one quadrant of the revolving stage from which all productions are to be broadcast. Sound resistant curtains across the front of each seating area make it possible to use the two sides alternately for alternate programs, or jointly when desired. When the curtain is drawn on one section, at the end of a program, spectators can leave it and a new audience can assemble there for a later program without disturbing the next succeeding broadcast which is viewed meanwhile from the other audience section.

The design was adopted following a study of facilities and experience at G-E's television station, WRGB, Schenectady, and in the light of Austin's experience in the design

(Continued on Page 30)



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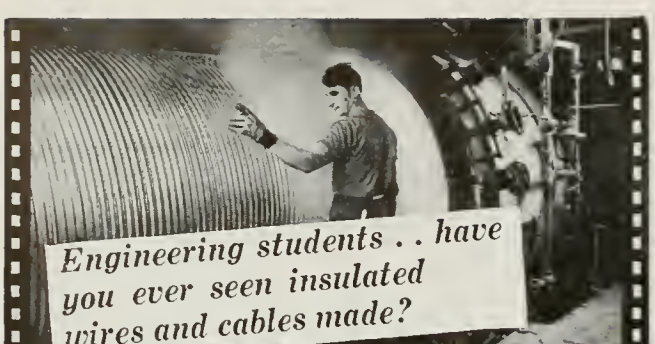

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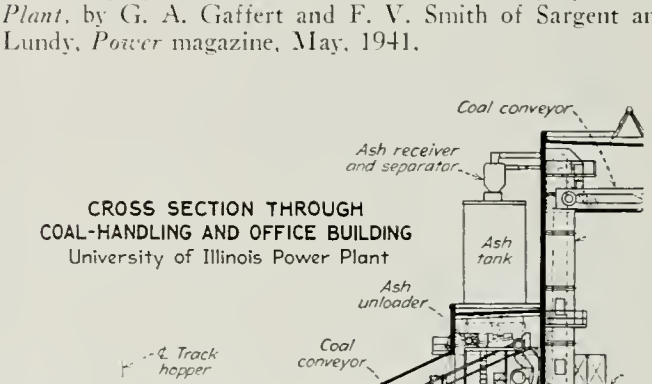
ABBOTT POWER PLANT . . .

(Continued from Page 9)

load areas, each being fed by a circuit from the power station (41conductor, No. 00 underground cables) with emergency reserve feeders running through the several areas. Station auxiliaries operate at 440 volts and are supplied by two 750KVA transformers from the main lines, one transformer being a spare. Auxiliaries are fed from groups of air circuit breakers, being either manually or electrically operated, as conditions would require.

The author wishes to acknowledge thanks to Mr. Charles E. Markland, Supervising Engineer, Physical Plant Department, and to Mr. John Doak, Superintendent of Buildings and Grounds, for their most helpful suggestions and criticism.

Bibliography: Reasons Behind the University of Illinois Plant, by G. A. Gaffert and F. V. Smith of Sargent and Lundy, *Power* magazine, May, 1941.



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That was not always so; the pre-war television "eye" needed as much sunshine as it could get to illuminate the scene. The same was true of football—final quarters were occasionally "washed out" on the television screen.

But thanks to research, conducted at the RCA Laboratories, a new super-sensitive television camera, rivaling the human eye in its ability to see under conditions of poor light is in prospect for the post-war world. Then, by television you will see every last-minute play of the ball game as clearly as if you were in the stands. Entertainment, sports, news events will pass before your eyes with every detail, every shadow faithfully reproduced.

Today, RCA's research facilities are devoted to providing the fighting forces of the United Nations with the best radio and electronic equipment available. Tomorrow, these same skills will continue to serve America in developing and creating new and finer peacetime products.

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OWI Photo by Palmer, in an Allegheny Ludlum Plant

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It is under such war conditions that Allegheny Ludlum steels have proved their worth. Right now they're helping to uphold the traditions of a free America, so that all of us may retain them in the future. When peace is restored, Allegheny Metal and other alloy steels will take their rightful place again in the enrichment of the post-war world.

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VACANT ELECTRON SPACES IN ATOMS MAKE METALS RUST-RESISTANT

Vacant spaces in the atoms of nickel are responsible for its resistance to corrosion or "rusting," Dr. Herbert H. Uhlig, metallurgist of the General Electric Research laboratory, told the Electrochemical Society meeting here this morning.

In earlier researches, he found that the stainlessness of stainless steel is not due primarily to the formation on the surface of a film of oxide, as formerly supposed. Instead it results from the electronic arrangement in the atoms of the alloy. Now he finds that the same thing is true for two other widely used corrosion-resistant alloys. One is copper and nickel (Monel) and the other molybdenum, nickel and iron (Hastelloy).

An atom may be though of as a nucleus around which revolve, somewhat in the manner of planets around the sun, from one to 92 electrons. These move in from one to seven different orbits or shells. Ordinarily one shell is filled with electrons before the next one begins, though in the case of certain "transition" elements there are vacancies in the shell next to the outer one. In nickel, for example, there are only 8 electrons in the third shell, instead of the 10 it could hold, despite the fact that there are two electrons in the fourth and outermost shell. With inner shells completely filled, a metal is more subject to corrosion.

Because of the vacancies nickel is very resistant to corrosion, but it is too expensive for many applications, and so it is alloyed with copper which is lower in cost. The atom of copper has one more electron than that of nickel. In the alloy these extra electrons go to fill the vacancies in the nickel atom. However, as long as any vacancies remain in the nickel the alloy still resists corrosion as well as pure nickel.

Finally, when the proportion of 60 per cent copper and 40 per cent nickel is reached all the nickel vacancies have been filled. Further increasing the proportion of copper makes the alloy less resistant until pure copper is reached, which corrodes much more than pure nickel. In the alloy of nickel with molybdenum and iron a similar effect occurs, says Dr. Uhlig.

FASTEST MOTOR REVOLVES 2,000 TIMES PER SECOND

An electric motor operating at the record-breaking speed of 120,000 revolutions per minute, or more than seven million revolutions per hour, 65 times faster than the conventional motor used in the home washing machine or refrigerator, has been built and tested by General Electric. Motors of this type will be used for the grinding and drilling of essential parts of airplanes and other war equipment and will not be available for general use until after the war.

This new motor, rated at three horsepower, weighs only seven pounds, as contrasted with the conventional three-horsepower motor which weighs 105 pounds. It is so small that the entire motor will fit into the palm of a person's hand, and its rotor is scarcely larger than a man's thumb. The motor is water cooled, using about one-half a gallon of water a minute, and is equipped with an oil-mist lubricating type of bearing. Tests including a continuous run of eight hours have proved its perfection. With normal voltage applied at 2,000 cycles, the new motor reaches full speed in less than a second.

"It's hard to realize speeds of 2,000 revolutions per second in a motor," D. H. Ware, motor engineer of the company, pointed out. "However, if the wheels of an automobile could be made to turn at the same speed, the auto would move at the rate of 10,000 miles per hour, or 165 miles per minute. This is about 14 times the speed of sound."

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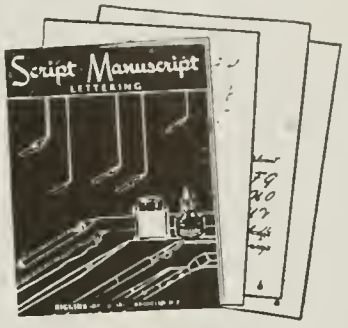

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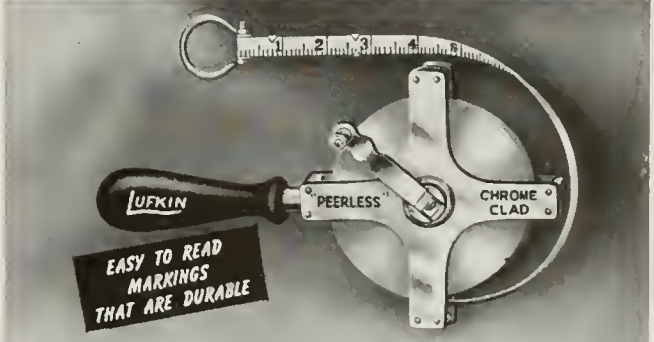

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PLASTICS AND METAL WILL PLAY JOINT ROLE AFTER WAR

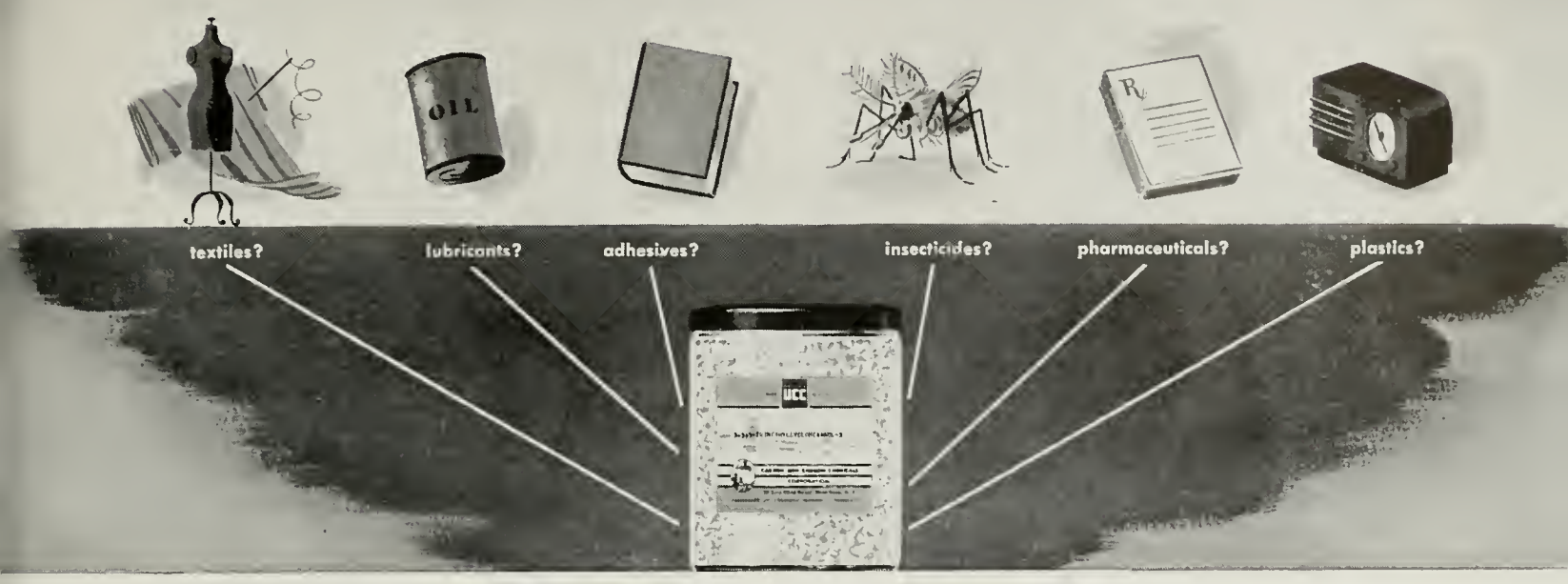
A one-man debate on the post-war potentialities of plastics as opposed to metals ended recently in a draw, with the conclusion that each would complement the other to everyone's benefit. This conclusiion was reached by Dr. A. Allan Bates, manager of the Chemical and Metallurgical Department of the Westinghouse Research Laboratories in East Pittsburgh, Pa. He weighed the pros and cons of "Metallic versus Nonmetallic Materials in Engineering" for the Cleveland section of the American Institute of Electrical Engineers.

More metals will be used in the future because their partnership with plastics will make possible many new products, according to Dr. Bates. More and more, plastice and metals will team together to bring us vastly improved airplanes, automobiles, electric generators and motors, and thousands of other industrial products. In some cases the two will cross bats as rivals until the better one wins out. But despite the contention of some partisans who claim that plastics and synthetic resins eventually will be used for everything except food, there are innumerable articles that will be metal for years to come. Among them are automobile crankshafts and valves, electric transmission lines, electric motor armatures and many other things which require conductivity and stability at very high temperatures.

Dr. Bates explained in this connection that plastics burn or melt at temperatures which have little effect on most metals, and plastics are not useful as conductors of electricity. They already are formidable rivals of the family of metals because they have esthetic appeal, corrosion resistance, lightness with strength, and other important engineering properties. They can be made from such abundant raw materials as coal, air, water, wood, and cotton.

The cost factor still gives metals the advantage in many cases. Various plastics cost from about 20 cents to $1 a pound, while steel can be produced for several cents a pound, copper at 12 cents, and aluminum at 15 cents. The economic advantage held by some metals may diminish in the most distant future as high-grade ores are worked out and we have to process progressively lower grades. Dr. Bates, a native of Elyria, Ohio, was educated at Ohio Wesleyan University and at the Case School of Applied Arts, where he was instructor and professor of metallurgy prior to joining Westinghouse in 1937.

What would you do with some 3,3,5-trimethylcyclohexanol-1?



EVEN *we* know only a little of what you might do with it... yet, Trimethylcyclohexanol (you pronounce it try'-meth'-il-sy'-klo-hex'-an-ohl) is a new industrial chemical by CARBIDE AND CARBON CHEMICALS CORPORATION... made with atoms obtained from common substances, rearranged into molecules that are not known to exist in nature.

What's this new synthetic organic chemical good for? No one yet knows all of the useful things it might be made to do. If you are technically minded you'll find some of the facts so far discovered in the italicized paragraph at the right. Whatever your interest, you will be glad to know that this new chemical has potential uses in the making of such things as medicines, plastics, lubricating oils, and adhesives.

In their service to industry as incubators for raw materials, the laboratories of this Unit of UCC are continually developing such new chemicals. An almost predictable percentage of them prove to be extremely valuable. Out of hundreds already developed have come scores from which scientists in industry have developed useful products of many kinds.

Some of the chemicals are used to make superior anti-freezes. Others are raw materials for quantity production of vitamins and life-saving drugs. Still others make possible improved cosmetics, plastics, textiles, photofilm, insect repellents, anesthetics... and hundreds of things of benefit to you in your daily life.

Through continuing research which is developing new materials out of common substances, CARBIDE AND CARBON CHEMICALS CORPORATION is helping to make many things more plentiful or more useful. And the research of this one Unit... in that field which often must appear to the layman as "unknown chemicals"... gives you an idea of what the combined research of all UCC Units in many basic fields means to you.

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As Trimethylcyclohexanol is one of the newest additions to this family of synthetic organic chemicals, its story is still incomplete. It is an alcohol with a high boiling point (388° Fahrenheit). At room temperature, it is a white solid with an odor like menthol. It dissolves in other alcohols, gasoline, benzene, ethers, and vegetable oils like linseed oil, but does not dissolve in water. It can be supplied in carload quantities if and when the need arises.

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TELEVISION STUDIOS . . .

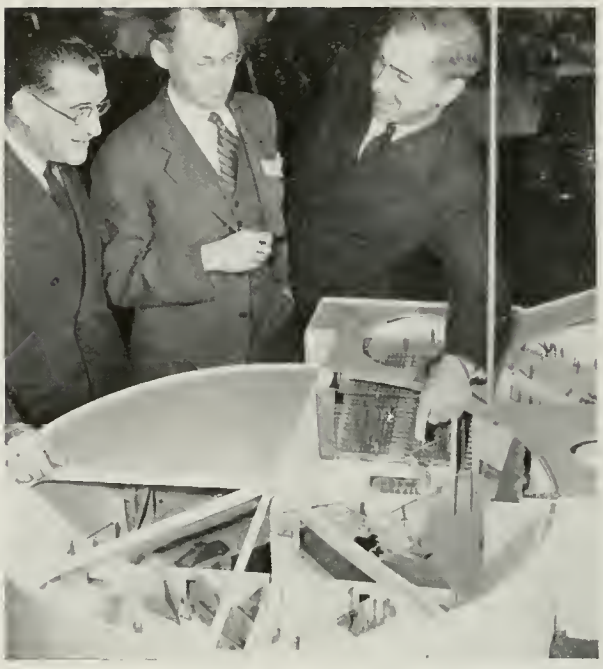
(Continued from Page 22)

and construction of facilities for communications and entertainment industries.

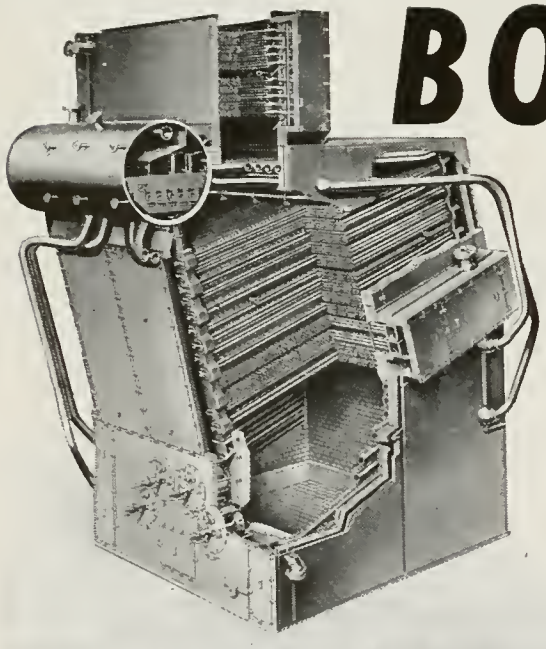
The studios have been planned along modern, functional lines with a welded rigid frame steel structure which supports several cantilevered television cameras, as well as the circular roof in the stage area. With one of these cameras mounted on the pivotal column in the center of the revolving stage and the others on the sides, it is possible to cover every part of the stage, at any distance and from every angle. The same cameras can be directed toward the audience for visual broadcasts of audience participation. Similar flexibility is provided in the system of high level studio illumination, which uses water-cooled mercury vapor lamps operated by remote controls. Lighting, noise and atmospheric conditions are subject to complete control in all parts of the building, which utilizes special insulated wall and roof construction developed by Austin engineers for the efficient, economical air-conditioning of large windowless, control conditioned industrial plants.

Spacious backstage areas around the revolving stage are available for construction of sets, storage of sponsors' exhibits or other equipment. Stage receiving doors are large enough to handle small aircraft and room-size displays. Offices, camera rooms, dressing rooms, sponsors' observation rooms, and other auxiliary facilities are provided on the first floor, below the audience seating areas and the control room. A lofty lobby and exhibition hall extends across the entrance facade.

MODEL STUDIO



Examining a model of future television studio are W. C. Bowman, editor of Engineering News-Record, J. K. Gannett, vice president of the Austin Company, and Dr. W. R. C. Baker, in charge of electronic development at G. E.



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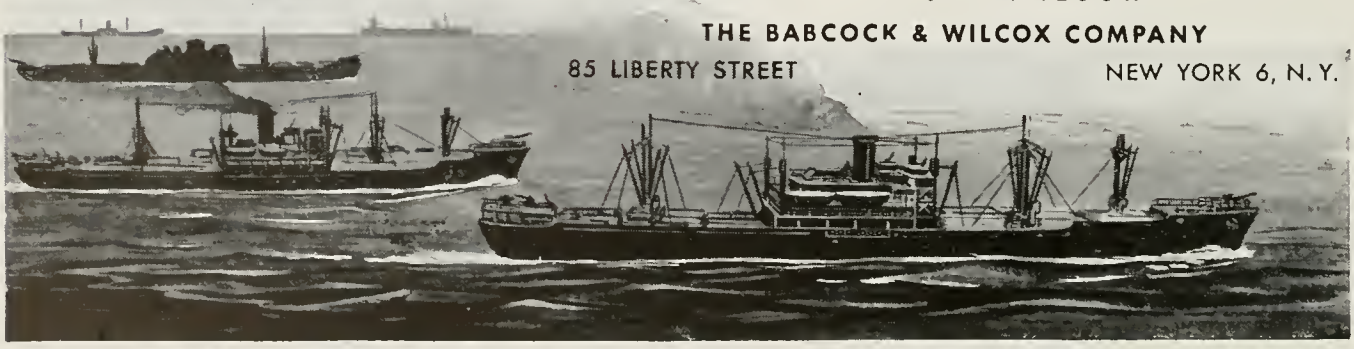

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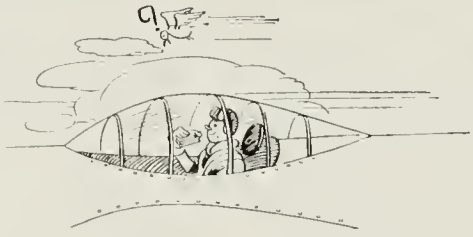
Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD



AUTOMATIC PILOT

FLYING blind most of the time, a pilot has a hard job keeping his plane on its course. An automatic pilot, electrically-driven, allows him to relax occasionally . . . to save his physical and mental resources for the job that may, and often does, lie far ahead.

An electric motor spins 12,000 revolutions per minute to keep the gyroscopic mechanism, guiding power of the automatic pilot, rotating at constant speed. The unit is tightly sealed to insure constant speed of rotation even when the air outside contains many dust particles, or its temperature is very low.

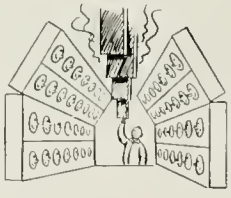
The automatic pilot is able to take over the controls and hold the plane on a predetermined course. Any pitch, roll, or yaw—that is, lengthwise or crosswise tilt or turn of the plane—produces an electric signal in the G-E automatic pilot. This signal is amplified and converted into hydraulic power which moves elevators, ailerons, and the rudder to bring the plane back to its correct position.

FLYING SUITS

WHEN planes land in unpopulated regions, or when fliers have to bail out in the middle of nowhere, there is comfort to a General Electric flying suit. Even when not plugged in, the suits can take rugged terrain, strenuous action, and cold weather.

A short time ago some G-E engineers spent two days and nights in the suits on Mt. Cranmore and Mt. Washington in New Hampshire. They skied, hiked, blazed trails, and camped out in heavy snowdrifts at temperatures close to zero.

After the ordeal, men and suits were doing nicely. The men had kept warm; the suits had withstood the wear; and the electric circuits built into the clothing operated perfectly when they were plugged in.



SPEED DRYING

DRYING time has been cut from six hours to 27 minutes on airplane instrument cases by using the new General Electric infrared Drying Lamps. These lamps are one of the important "little things" that G.E. is manufacturing to speed things up on the production front.

These lamps are being used in many war industries to dry everything from paint on tanks and jeeps to photographic film and the glue on envelope flaps. In addition, some are designed for roving jobs such as drying out important equipment after it has been drenched by floods. Equipment speedily dried is frequently salvaged with little loss. *General Electric Company, Schenectady, New York.*

Hear the General Electric radio programs: "The G-E All-girl Orchestra" Sunday 10 p.m. EWT, NBC—"The World Today" news, every weekday 6:45 p.m. EWT, CBS.

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